



9th cidb

POSTGRADUATE CONFERENCE

Emerging Trends in Construction Organisational Practices and Project Management Knowledge Areas



ISBN - 978-0-620-69590-9

1-4 FEBRUARY 2016

THE RIVER CLUB | CAPE TOWN, SOUTH AFRICA

PROCEEDINGS



Editors

A/Professor Abimbola Olukemi Windapo,
Mr. Sunday Julius Odediran and
Mr. Abdulrauf Adediran
University of Cape Town, Cape Town, South Africa
First published in February 2016,
Cape Town, South Africa

ISBN - 978-0-620-69590-9

Published by:

Department of Construction Economics and Management
University of Cape Town, Cape Town, South Africa
Email: c/o abimbola.windapo@uct.ac.za

© The copyright for papers in this publication belongs to authors of the papers.

Declaration

A total of 121 abstracts were received for the conference from Universities located in Egypt, Ghana, Hong Kong, New Zealand, the Netherlands, Nigeria, South Africa and the United Kingdom; out of which 55 full papers were accepted. All full papers in this publication went through a double-blind peer review process which involves abstracts assessment by a scientific committee panel, feedback to authors on abstracts submitted, submission of full papers for the accepted abstracts, review of full papers by the scientific committee and panel of reviewers, feedback to authors on full paper submitted which included decision on acceptance and evaluation of the revised papers by the scientific committee and reviewers to ensure quality of content.

Professional accreditation

The 9th cidb Postgraduate Conference is accredited by the South African Council for the Project and Construction Management Professions (SACPCMP) for 15 CPD Hours under Category A: Core, with Validation Number: SACPCMP/CPD/16/001.

Correspondence

All correspondence relating to the 9th cidb Postgraduate Conference should be addressed to:

Mr. Sunday Julius Odediran
Conference Secretary
Email: oddsun001@myuct.ac.za

For more information, please visit the conference website:

www.cidb-pg-conf.uct.ac.za



PREFACE

Dear conference participants,

It gives me great pleasure to welcome you to the 9th cidb postgraduate conference on *“Emerging Trends in Construction Organisational Practices and Project Management Knowledge Areas”* in the beautiful city of Cape Town – the World Design Capital, 2014. The conference is organized under the auspices of the University of Cape Town and Cape Peninsula University of Technology as collaborators.

Society faces considerable challenges with respect to construction project procurement, delivery and management. In addition, there is the problem of lack of transformation in the construction industry, due partly to the inability of significant numbers of emerging contractors to grow and develop sustainably, not only in South Africa, but also on the African continent. Besides these new challenges, problems persist around the productivity, effectiveness and efficiency of processes in the construction industry, the inability of the construction industry to expand as a vehicle for job creation for both unskilled and skilled workers, provide the much-needed houses and provide solutions to problems of unsustainable construction practices, project development and procurement.

Over the last decade, the construction industry has been at the forefront of developing innovative solutions such as green buildings, new materials, procurement methods, management and organizational practices to overcome these challenges. The coming decade will require more innovative solutions to deal with current and future

challenges. However, these challenges often require the collective efforts of industry and science. Sharing experiences and ideas in the area of construction project delivery, strategic management, organisational practices and procedures in construction remains an ongoing priority. Organisations such as the cidb and SACPCMP all contribute to this continuous activity of developing, sharing and disseminating practical and scientific knowledge.

In order to stimulate interaction between the conference participants, the organising committee has designed a programme, which enables different opportunities for networking, learning and discussions. In addition to keynote addresses from invited speakers and parallel paper sessions, the conference will host three very auspicious master classes. The subjects of these master classes are all related to current developments in construction research and practice. Looking at the contributions submitted to the parallel paper sessions and the enthusiasm shown by the master class coordinators, I am convinced that this will be a very stimulating event, leading to new insights, probable solutions to some of the challenges facing the construction industry and followed by many joint (research) initiatives. Finally, I wish to thank all those individuals who played an important role in the organisation and support of the 9th cidb Postgraduate Conference.

I wish you all a stimulating conference and a pleasant stay in Cape Town, the Mother City!

A/PROF ABIMBOLA WINDAPO

CHAIR, 9th cidb Postgraduate Conference

FOREWORD

by the CEO of cidb

The cidb Act mandates the cidb to support human resource development in the construction industry by establishing best practices and advising organs of the state on human resource development in relation to the construction industry. To achieve this, the cidb has since 2004 been collaborating with universities that offer construction management related qualifications to host a successful postgraduate conference series.

The cidb is pleased to welcome you to this 9th edition of the cidb Postgraduate Conference hosted by the Department of Construction Economics and Management of the University of Cape Town, in partnership with the Cape Peninsula University of Technology. It is my belief that you will enjoy the conference that comes at a very critical time in our transformation journey as an industry. The main theme of this conference is:

*Emerging trends in construction organisational practices
and project management knowledge areas*

These have a direct bearing on the transformation journey of the country as we grapple with how best to create a just, fair and inclusive society where all are equally valued for their contributions, to the nation building project. I sincerely hope that as you debate the emerging trends in construction organisational practices, you will pay special attention to issues of transformation of the industry as well as your roles as academics. The cidb encourages all participants to work together collectively to transform this industry.

It therefore gives me great pleasure to welcome all participants, and trust that this meeting will continue to provide an on-going platform for interaction between researchers, public sector clients and private industry to discuss issues of significance to the industry. I would also wish to reiterate the cidb's continued commitment to conferences such as these and the contribution they make to the development of the next generation of academics and practitioners in the industry.

I want to thank the conference organisers under the capable guidance of A/Prof Abimbola Windapo of the University of Cape Town, and to also thank the University of Cape Town, Cape Peninsula University, South African Council for the Construction and Project Management Professions (SACPCMP) and NMC Construction for their support.

MS HLENGIWE KHUMALO

Acting CEO, Construction Industry Development Board
February 2016



Local Organising Committee

A/PROF. ABIMBOLA WINDAPO
University of Cape Town (Chair)

DR. JULIUS FAPOHUNDA
Cape Peninsula University of Technology

MS. NTEBO NGOZWANA
Construction Industry Development Board (cidb), South Africa

MR. SUNDAY ODEDIRAN
University of Cape Town (Secretary)

MR. ABDULRAUF ADEDIRAN
University of Cape Town

Scientific Committee

A/PROF ABIMBOLA WINDAPO (CHAIR)
University of Cape Town, South Africa

PROF AKINTOLA AKINTOYE
University of Central Lancashire, UK

PROF ALFRED NGOWI
Central University of Technology, South Africa

PROF CHIMAY ANUMBA
Pennsylvania State University, USA

PROF DAVID ROOT
University of the Witwatersrand, South Africa

A/PROF EZIYI IBEM
COVENANT UNIVERSITY, NIGERIA

A/PROF FIDELIS EMUZE
Central University of Technology, South Africa

PROF GARY HOLT
University of Central Lancashire, UK

PROF GEORGE OFORI
National University of Singapore, Singapore

PROF GODWIN JAGBORO
Obafemi Awolowo University, Nigeria

PROF JACK GOULDING
University of Central Lancashire, UK

DR JAMES ROTIMI
Auckland University of Technology, New Zealand

PROF JOHN SMALLWOOD
Nelson Mandela Metropolitan University, South Africa

DR JULIUS FAPOUNDA
Cape Peninsula University of Technology, South Africa

PROF KAJIMO SHAKANTU
University of the Free State, South Africa

PROF KATHY MITCHELL
University of Cape Town, South Africa

PROF KEITH CATTELL
University of Cape Town, South Africa

DR NIEN-TSU TUAN
University of Cape Town, South Africa

A/PROF OLABODE OGUNSANMI
University of Lagos, Nigeria

PROF PAUL BOWEN
University of Cape Town, South Africa

PROF PD RWELAMILA
UNISA Graduate School of Business Leadership, South Africa

DR RODNEY MILFORD
Construction Industry Development Board, South Africa

PROF SAM WAMUZIRI
A'Sharqiyah University, Oman

PROF SYED AHMED
East Carolina University, USA

PROF WILL HUGHES
University of Reading, UK

SUNDAY ODEDIRAN (CONFERENCE SECRETARY)
University of Cape Town, South Africa



Panel of Reviewers

DR. JULIUS AGUMBA
University of Johannesburg, South Africa

DR. CLINTON AIGBAVBOA
University of Johannesburg, South Africa

DR. AYODEJI AIYETAN
Durban University of Technology, South Africa

DR. KOLA AKINSOMI
University of Witwatersrand, South Africa

DR. YOMI BABATUNDE
University of Witwatersrand, South Africa

DR. TABARAK BALLAL
The University of Reading, UK

DR. RICHARD JIMOH
Federal University of Technology Minna, Nigeria

DR. MANYA MOOYA
University of Cape Town, South Africa

DR. GRACE OJO
Obafemi Awolowo University, Nigeria

DR. TUNDE OLADOKUN
Obafemi Awolowo University, Nigeria

DR. AKINTAYO OPAWOLE
Obafemi Awolowo University, Nigeria

DR. LUQMAN OYEWOBİ
Federal University of Technology Minna, Nigeria

DR. CHIKA UDEAJA
Northumbria University, UK

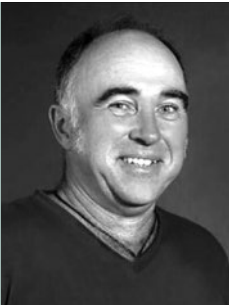
Sponsors

We would like to express our gratitude to the following sponsors of the 9th cidb Postgraduate Conference, Cape Town.



More information about our sponsors is available at the conference website: www.cidb-pg-conf.uct.ac.za

KEYNOTE SPEAKERS



PROF. JOHN SMALLWOOD

Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

Prof. John Smallwood is Professor and Head, Department of Construction Management, and Programme Director, MSc (Built Environment) Programme, and a member of Construction Research Education and Training Enterprises (CREATE), which consultancy specialises in construction health and safety (H&S), and quality. Notable latter related contributions include those to the cidb H&S and quality status reports.

PREVENTING COLLAPSE OF REINFORCED CONCRETE STRUCTURES AND SUPPORT WORK: ASSURANCE VERSUS 'ACCIDENT INVESTIGATION'

- Construction Management is a discipline and a profession not an acquired title or term
 - Failure of management versus the myth of 'accidents'
 - Quality management and health and safety management: The 'stay standing' duo
 - Construction Managers convert vision to reality: The implications!
-



PROF. PANTELEO RWELAMILA

University of South Africa (UNISA), Midrand, South Africa

Prof. Rwelamila is a project management and procurement expert specialising in procurement policy, infrastructure procurement and management of risks and contracts management. He has experience of more than 30 years in consulting in construction economics, policy development and conducting studies in project appraisal, project planning, procurement, contract formulation and management, project performance evaluation and strategic project management.

INFRASTRUCTURE DEVELOPMENT THROUGH PUBLIC PRIVATE PARTNERSHIPS (PPPS): WRESTLING WITH TWIN CHALLENGES IN EMERGING ECONOMIES – FROM RHETORIC TO REALITY

- What constitutes the public side of PPPs?
- Marginalization and management of the public as principal stakeholders
- The need for a paradigm shift from exclusion to inclusion in PPP arrangements
- Conceptual model for appropriate stakeholder management in PPP projects

PROF. ALFRED NGOWI

Central University of Technology, Bloemfontein, South Africa

Prof. Alfred Ngowi is a professor in Civil Engineering and the dean of the Faculty of Engineering and Information Technology at the Central University of Technology, Free State. He is a NRF rated scientist in construction engineering and management and has published over 100 articles in journals, book chapters and conference proceedings. He is the co-chief editor of the Journal of Construction in Developing Countries (JCDC); Associate Editor of Built Environment and Asset Management (BEPAM) and reviews editor of the Botswana Journal of Technology (BJT).



WHAT THE CONSTRUCTION INDUSTRY NEEDS TO KNOW ABOUT SUSTAINABLE DEVELOPMENT GOALS

- At its seating in September 2015 the UN General Assembly declared 17 Sustainable Development Goals (SDGs) to be accomplished by 2030.
- Of the 17 SDGs, 4 are very closely associated with the built environment and these cannot be achieved without the participation of the construction industry.
- The global campaign for SDGs presents a significant new opportunity for the construction industry.
- Construction companies could create competitive advantage by branding themselves or in partnership with others as leaders in sustainable development.

PROF. JAN WIUM

Stellenbosch University, Stellenbosch, South Africa

Prof. Jan Wium, received his Civil Engineering degree from the University of Pretoria in 1979 and a master's degree in 1985. He holds a PhD from EPFL in Switzerland. After working as structural engineering consultant for 20 years, he joined Stellenbosch University as lecturer in 2003. Since 2010, he holds the Chair in Construction Engineering and Management position, focusing on modular construction, risk management and constructability in construction.



TRENDS IN CONSTRUCTION ENGINEERING AND MANAGEMENT

- The current status of project delivery: Projects have a tendency to be completed over time and over budget, quite often as a result of scope and design changes
- Tendencies in project design: Design of projects become more and more automated with sophisticated software providing support to the design engineer
- Trends in management and execution of projects: Management tools such as Building Information Models enable projects teams to improve collaboration and management of design and costing. Tools are however fragmented and a cohesive approach is needed
- Identified needs for improvement of the project execution phase: Items identified based on comparisons between in-situ concrete and precast concrete construction

KEYNOTE SPEAKERS



ISHMAIL CASSIEM

Construction Industry Development Board, South Africa

Ishmail is a Manager in the Construction Industry Performance Programme at the Construction Industry Development Board (cidb), responsible for performance improvement, development of best practices, standards and health and safety policies in the construction industry. He holds an MSc in Project Management. He has 30 years' experience in the construction industry working for civil engineering contractors, the CSIR, and a training company. He participates in various committees at the South African Council for the Project and Construction Management Professions (SACPCMP).

INTRODUCTION OF A REGISTER OF PROFESSIONAL SERVICE PROVIDERS

- Proposed framework for the cidb Register of Professional Service Providers
- cidb Register of Professional Service Providers; Registration Criteria
- Professional Service Provider Recognition Scheme
- Best Practice: Management Systems
- Best Practice: Membership of a Voluntary Organization
- Standard for Professional Service Providers Performance Reports



BONKE SIMELANE

Group Corporate Services Director, NMC Construction Group, South Africa

Bonke Simelane is Group Corporate Services Director for the NMC Construction Group which he joined in 2012. He is the incoming Vice-President of Master Builders South Africa. He is also a Council Member of the South African Council for the Construction and Project Management Professions (SACPCMP) where he is a member of the Construction Management Development Committee.

NOMVULA RAKOLOTE

Central University of Technology, Bloemfontein, South Africa

Nomvula Rakolote is the Registrar of the South African Council for Project and Construction Management Profession (SACPCMP).

The South African Council for Project and Construction Management Professions (SACPCMP) is a statutory body established by section 2 of the Project and Construction Management Act (Act No.48 of 2000).

The SACPCMP regulates the Project and Construction Management Professions in order to protect the public.

She has, with the support of Council hosted three annual Project and Construction Management Professions Conference SACPCMP Conference that focused on the growth, development and transformation of the professions. While her primary task is mere registration of professionals, accreditation of institutions who offer training and development in the Built Environment, particularly, Project and Construction Management, she believes that without the growth of the industry, it would be difficult to ensure development of new talent, especially those from historically oppressed communities.



TABLE OF CONTENTS

Emerging Trends In Construction Projects Delivery	1
The Trends In Construction Output Forecasting Studies Over The Last 25 Years Lam, Ka Chi; Oshodi, Olalekan Shamsideen	2
Forecasting Construction Demand: A Comparison Of Box-Jenkins And Support Vector Machine Model Lam, Ka Chi; Oshodi, Olalekan Shamsideen; Lee, Eric Wai Ming	14
Modeling The Relationship Between The Initial Tender Sum, Duration And Final Construction Cost Of Building Projects In Nigeria: A Proposed Study Oboirien, Momoh Ohiomah	24
Theorizing Speculative Low-Income Housing Development In Developing Countries Taruvunga, Bridgit Gugulethu; Mooya, Many Mainza	34
An Investigation Into Studio-Based Pedagogy For Built Environment Graduates: A New Model For A New Context Bremer, Tascha; Els, Mart-Mari	44
Challenges In The Delivery Of Environmental Sustainability In Housing Development In Abuja, Nigeria Ishaya, David Ayock; Dabo, Daniel I.; Fadason, Ruya T.	53
Evaluating The Budgetary Reliability Of Design Stage Elemental Cost Plan In Building Procurement: A New Zealand Study Adafin, Johnson Kayode; Wilkinson, Suzanne Jane; Rotimi, James Olabode Bamidele; Odeyinka, Henry Agboola	60
Tender Price Index Development: A Critical Literature Review Of Models For Prediction Kissi, Ernest; Adjei-Kumi, Theophilus; Badu, Edward	71
Towards An Integrated Sustainable Procurement Model For The Nigerian Construction Industry: A Review Of Stakeholders' Satisfaction With Current Regimes Ogunsanya, Oluwabunmi Ayopo; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington	82
Financial Performance Of Multinational Construction Companies In South Africa Odediran, Sunday Julius; Windapo, Abimbola Olukemi	92

TABLE OF CONTENTS

Conceptual Framework Of Influencing Factors For Design Documentation Quality Akampurira Emmanuel; Windapo, Abimbola Olukemi	102
The Role Of Public Private Partnerships In The Provision Of Infrastructure Projects Bwanali, Salim; Rwelamila, Pantaleo D.	112
A Study Of The Relationship Between Material Waste And Cost Overrun In The Construction Industry Saidu, Ibrahim; Shakantu, Winston	124
A Concept: Strategic Maintenance Management For Built Facilities Of Universities Adamu, Anita Dzikwi; Shakantu, Winston	135
Evaluation Of The Globalisation Readiness Of Medium Sized Contractors In The South African Construction Industry Anugwo, Iruka C.; Shakantu, Winston M.	142
Assessing The Implications Of Public Sector Procurement On Construction Health And Safety Management In Zimbabwe Benviolent, Chigara; Smallwood, John	152
Framework For Contractors' Bid Success In Nigeria: SWOT Approach Fawale, Tolulope Samuel; Dada, Joshua Oluwasuji	162
The Effects Of Architectural Design On South African Expanded Public Works Programme Goals Splaingard, Daniel Robert	172
Impediments To Implementation Of Green Buildings In South Africa Saad, Mohammed Mustapha	182
The Perceived Barriers To The Construction Of Green Buildings In Nelson Mandela Bay, South Africa Zenios, Marco; Allen, Christopher James	191
The Practice Of Design-Build Procurement Method In South Africa Ilori, Babasola Olubunmi; Talukhaba, Alfred Atsango	202
Planning, Housing Policy And Low Income Housing Development In South Africa Musvoto, Elizabeth Mirika; Mooya, Manya Mainza	209

TABLE OF CONTENTS

Construction Trends In Strategic Management	219
Workers' Safety On Construction Sites: Use Of Ppes In Lesotho Emuze, Fidelis; Khetheng, Alice	220
Factors That Influence Real Estate Project Investment: Professionals' Standpoint Abidoeye, Rotimi Boluwatife; Chan, Albert P. C.; Oshodi, Olalekan Shamsideen	229
Workers' Perceptions Regarding Health And Safety (H&S) Practices In The Nigerian Construction Industry Kukoyi, Patricia; Smallwood, John	240
Impact Of Project Manager's Leadership Competences On Complex Mega Infrastructure Project Performance: A Literature Review Nyariranwge, Maxwell; Babatunde Oluwayomi	249
The Use Of Building Information Modelling And Related Technology In The Cape Town Urban Centre Pinfeld, Laura; Fapohunda, Julius Ayodeji	260
The Impact Of Load Shedding On The Construction Industry In South Africa Coetzee, Drian; Els, Mart-Mari	268
An Exploratory Study Into The Influence Of Supervisory Reward Techniques On Construction Workers Productivity In Bellville, South Africa Opperman, Alvin Graham; Ndiokubwayo, Ruben; Nani, Gabriel	277
A Framework For Managing Contextual Influence On Health And Safety In Construction Projects Umeokafor Nnedinma; Windapo, Abimbola Olukemi	285
Risk Management For Multinational Collaborations: Application On The Case Study Of Grand Egyptian Museum Khodeir, Laila Mohamed; Ahmed, Omar Hesham	295
Trends In Cultural And Societal Management Of Cement Mural In Ghana Micah, Victor Kweku Bondzie; Donkor, Evans Kwadwo	309

TABLE OF CONTENTS

Employee's Safe Acts Towards Health And Safety Compliance In Ghana Mustapha, Zakari; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington	319
Perceived Risk Impact On Marketing Of Construction Professional Services Ojo, Grace Kehinde; Ebunoluwa, Esther Ilori; Odediran, Sunday Julius	327
Stakeholder Management; A Literature Review Of Historical Development And Current Trends Eyiah-Botwe, E.; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington	337
Building Information Modeling In Nigeria And Its Impact On Collaboration In Schematic Design Stage And Post Contract Stage Of Design Onungwa, Ihuoma Onyinyechi; Uduma-Olugu, Nnezi	348
Management Style And Quality Of Management During Construction Influences On Project Delivery Time Aiyetan, Ayodeji.Olatunji; Smallwood, John Julian; Shakantu, Winston	357
Identifying Hazards Facing Workers In Cement Factory In Pretoria Samuel, Segun Victor; Talukhaba, Alfred Atsango; Opaleye, Oladele Solomon	367
Influence Of Constructability And Quality Of Management During Design Factors On Project Delivery Aiyetan, Ayodeji.Olatunji; Smallwood, John Julian; Shakantu, Winston	376
Women Health And Safety In Construction Industry Alewi, Monisola Florence; Talukhaba, Alfred Atango; Opaleye, Oladele Solomon	386
Evaluation Of Health And Safety Planning Process On Construction Sites In Kaduna Metropolis, Nigeria Jimoh, Richard Ajayi; Omotayo, Omolara Shade; Windapo, Abimbola Olukemi	399
Impact Of Acquisition On Employee And Management Operation – The Case Of EPCM Organisation In RSA Kelani, Yakubu; Rwelamila, Panteleo D.	409
Public Private Partnerships For Roads Maintenance As A Vehicle For Skills Transfer And Enterprise Development In South African Rural Communities Matshidze, Lindelani; Oyegoke, Adekunle Sabitu; Ogunlana, Stephen	418
Effectiveness Of Electronic Tendering For Construction Projects Balogun, Ayodeji; Talukhaba, Alfred Atsango; Opaleye, Oladele	426

TABLE OF CONTENTS

The Aspect Of Labour In Hybrid And In-Situ Concrete Construction In South Africa Schreuder, Jan-Hendrik Michiel; Wium, Jan Andries	436
Artificial Intelligence For Sustainable Development Of Intelligent Buildings Adio-Moses, David Adunadepo; Asaolu, Olumuyiwa Sunday	446
Categorization Of The Duties And Required Competencies Of A Management Contractor Ayegba, Calistus; Laryea, Samuel	455
Formulating An Effective Public Private Partnership Policy For Housing Provision In Nigeria Urban Centres: A Conceptual Approach Gbadegesin, Job Taiwo; Harry van der Heijden; Boelhouwer, Peter; Oladokun, Sunday Olarinre	465
A Factorial Analysis Of Safety Performance Measures: A Study Among Construction Workers In Gauteng, South Africa Okoro Chioma Sylvia; Musonda Innocent; Agumba Justus Ngala	477
Quality Management A Fundamental Business Imperative For Construction Companies Mthi, Vuyolwethu Feza Philisa; Allen, Christopher James	486
Strategies For Effective Materials Management Towards Sustainable Construction Enhancement Solanke, Bukola H.; Fapohunda Julius A.	496
The Impact Of Implementing BIM On AEC Organisational Workflows Akintola, Adeyemi; Douman, Darcelle; Kleynhans, Matthew; Maneli, Sithembisile	506
An Investigation Into Supply Chain Management Processes Efficacy And Service Delivery Enhancement In The City Of Johannesburg Metropolitan Municipality Soni, Manqoba Sinothile Mholi; Kajimo-Shakantu, Kahilu	517
Evaluating The Impact Of Public Sector Targeted Procurement Strategies On The Development Of SMEs In The Construction Industry Adediran, Abdulrauf; Windapo, Abimbola Olukemi	526

TABLE OF CONTENTS

Emerging Trends In Organizational Practices And Procedures In Construction	537
The Use Of Social Media In Real Estate Transactions In Lagos, Nigeria Babatunde, Theophilus Olugbenga; Ajayi, Cyril Ayodele; Timothy Tunde Oladokun	538
Assessment Of Growth Challenges Among Small And Medium-Sized Construction Firms In Ghana Arthur-Aidoo, B. M.; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington	550

Emerging Trends in Construction Projects Delivery

THE TRENDS IN CONSTRUCTION OUTPUT FORECASTING STUDIES OVER THE LAST 25 YEARS

Lam, Ka Chi

Department of Architecture and Civil Engineering, City University of Hong Kong, Hong Kong SAR, China.

Oshodi, Olalekan Shamsideen

Department of Architecture and Civil Engineering, City University of Hong Kong, Hong Kong SAR, China.

Abstract

Construction output forecasting plays a crucial role in developing strategic plans for the construction industry. Various techniques have been used for construction output forecast research which includes: regression, artificial neural network and structural models, just to mention a few. An up-to-date systematic review of previous studies focused on construction output forecasting will provide insights into the current state of knowledge and gaps in the field. A three-step method was used to obtain relevant publication (15 papers met the inclusion criteria) and to compile a database of techniques and findings. It was found that statistical model is the most dominant method used to forecast construction output data. Four research gaps were identified in the review process. Continued efforts are needed to explore the application of artificial intelligence (AI) models in construction output forecast research. This can be attributed to the accuracy and reliability associated with the AI models in previous studies. Accurate construction output forecast is vital to the sustained growth of the construction industry.

Keywords: Construction industry, Construction output, Forecasting techniques, Systematic review

1 Introduction

The construction industry plays a pivotal role in the economic development process of any nation. Commentators have argued that the construction industry has strong links with the economy. Empirical evidence has shown that the construction industry output (hereafter termed construction output) tends to fluctuate with economic cycles (Chan, 2002, Goh, 2005, Lewis, 2004). Fluctuations in construction output create inefficiencies in the production process (Ofori, 1993; Ofori et al., 1996), bankruptcy and retrenchment within the construction industry during periods of low production (Jiang et al., 2013, Ng et al., 2008a). These fluctuations have detrimental effects on the construction industry and the economy in general. In addition, macro-level studies aimed at improving the construction industry have suggested the need for predictive models to aid long-term forward planning (Egan, 1998, Ng et al., 2008b). The accuracy and reliability of these predictive models are of strategic importance to the construction industry for sustained growth and planning purposes.

Forecasting construction output will aid and improve managerial decision making, policy formulation and sustained economic growth. Various time horizons and levels of aggregation are useful for strategic planning. For example, at construction company level, short-term

forecast is required for project scheduling and staffing; medium-term forecast for product development, pricing of tenders and marketing; and long-term forecast will be useful for decisions associated with capital investments (e.g. acquisition of new equipment) and exploration of new overseas market. Moreso, governments are interested in construction output due to its linkage with other sectors of the economy. Government intervention programmes during periods of economic recession is crucial to recovery (Goh, 2005, Jiang et al., 2013). Jiang et al. (2013) points out that the anticipated impact of such intervention policies was not achieved in Australia because it was halted too early. The ability to anticipate future trends would ensure the development and implementation of adequate response strategies aimed at reducing the impact of changes in construction output.

The purpose of this paper is to systematically review the current state of empirical literature on construction output forecasting. Although, several studies have tried to differentiate between construction output and construction demand (Goh, 1998). Gruneberg and Folwell (2013) assert that construction component of gross fixed capital formation can be used as a measure of construction output. In contrast, gross value of construction work was used as a measure of construction work (see Goh and Pin, 2000; Fan et al., 2010). Akintoye and Sommerville (1995) show that a lagged relationship exist between construction output and construction demand. It is evident that a thin line of difference exists between construction demand and construction output. Thus, construction demand will eventually filter into construction output. To date, there has been little or no studies focused on a systematic review of construction output forecasting research. Although, an earlier review was done by Fan et al. (2007), the main focus of that review was to identify factors affecting construction demand and the use of exponential smoothing technique to predict construction demand. Hence, this paper presents an up-to-date and more comprehensive review of the construction output literature, briefly discusses advantages and disadvantages of forecasting techniques and evaluates the accuracy of construction output forecast generated by various techniques.

2 Overview of Construction Output Forecasting Techniques

Numerous techniques have been developed for construction output forecasting. In construction-related literature, the earliest work was published by Tang et al. (1990). In this study, regression technique was used to forecast construction (aggregated into residential, non-residential and other) activities in Thailand. Construction output forecast research has been evolving leading to the use of new techniques. Empirical evidence also confirms that macro-economic variables are adequate and reliable for developing construction output forecast models (see Goh and Teo, 2000; Jiang and Liu, 2011). The techniques which have been used can be classified into four broad categories (methods) namely: statistical models (SM), structural time-series model (S), artificial neural network (ANN) and hybrid models (H). A detailed discussion on forecasting techniques can be found in the literature (Weron, 2014).

2.1 Statistical Models

Statistical models are based on the mathematical relationship between the dependent variable (current construction output) and a number of independent variables (i.e. determinants), this relationship is either known or estimated (Weron, 2014). Statistical models used in past studies (see Table 1) range from autoregressive integrated moving-average (ARIMA), multiple regression (MR), multiple loglinear regression (MLGR), autoregressive nonlinear regression (ARNLR), vector error correction (VEC), vector error correction model with dummy variables (VEC-D), panel ordinary least squares regression (P-OLS), and panel-vector error correction (P-VEC).

Statistical models can be divided into two subsets namely: stationary process and non-stationary process. Stationary time series possess statistical properties (such as mean, variance,

etc.) which are constant over time. In ARIMA class of models, stationary time series is an important process for fitting an ARIMA model and regression models (Goh, 1998). However, the use of co-integration and VEC forecast models ensure that valuable long-term relationship information is not lost during the transformation of non-stationary variables (Anderson and Vahid, 2011). Common to these models, construction output is expressed in terms of its past values and a white noise process. In addition, the parameters for other significant variables can be estimated in multivariate models such as multiple regression.

2.2 Structural Time-series Model

Structural time-series model are quite similar to statistical models. The main difference is that structural time-series model is based on estimating the relationship between trend, seasonal component and noise. Detailed discussions on structural time-series model can be found in Koopman and Ooms (2011).

2.3 Artificial Neural Network

Most of statistical models are linear predictors; however, construction output forecast is known to be a non-linear function of its input features. Thus, statistical models may not adequately predict construction output. In order to solve this problem, researchers have used artificial intelligence techniques such as Artificial Neural Network (ANN), which have the capacity to capture non-linear and complex data structures. Quantitative forecasting is based on the capacity to adequately map between input and output data. ANN possesses the capability to learn past patterns in data and extrapolate underlying patterns, which aids prediction of future outcomes (Shukla et al., 2010). Thus, ANN may be adequate for forecasting task.

2.4 Hybrid Models

Hybrid methods combine linear and non-linear modelling capabilities, thus, hybrid models complements on the strength and weakness of both approaches. Shukla et al. (2010) acknowledges that hybrid models possess the additional capabilities, which can improve forecast accuracy. An example of hybrid model used in Goh (2000) is an evolutionary ANN, which used genetic algorithm (GA) to evolve ANNs (GA-ANN).

3 Research Method

It is acknowledged that systematic reviews of previous studies extend the general understanding about a research problem. However, the findings of review studies are often questionable due to inexplicit methods (i.e. sampling approach, inclusion criteria, etc.). Although, a generally accepted standard for reporting systematic reviews do not exist; Booth (2006) suggests that the explicit use of STARLITE (STARLITE represents sampling strategy, type of study, approaches, range of years, limits, inclusion and exclusions, terms used and electronic source) will improve on the quality of systematic reviews. Thus, this review adopts a modified version of a method used in similar earlier reviews (Ke et al., 2009; Tang et al., 2010). These earlier reviews were limited to papers published in top-tier construction management journals as classified by (Chau, 1997). The inclusion criterion was modified so as to cover papers published in construction-related journals. As a result, three relevant papers published in Australian Journal of Construction Economics and Building, Building and Environment and Habitat International were obtained from the publisher's database. The process of acquiring papers related to the focus of this review was carried out in 3 stages.

Firstly, a systematic and comprehensive search was conducted under the "title/abstract/keyword" field of SCOPUS database search engine. The full search code is as follows:

TITLE-ABS-KEY ("Construction sector*" OR "construction output" OR "construction industry" OR "construction industry development" OR "construction demand" OR "model" OR "forecasting") AND KEY ("construction" OR "Forecasting")) AND DOCTYPE (ar OR re) AND SUBJAREA (mult OR arts OR busi OR deci OR econ OR psyc OR soci).

Despite these search criteria, the results of the initial search on SCOPUS included some publications that did not meet the study's inclusion criteria. Thus, the search results were scaled down by focusing on papers published in construction-related journals between 1990 and 2014 (years inclusive). In the second stage, a brief review of the abstracts of the papers was conducted; this was done so as to exclude less-related or unrelated papers. In addition, publications classified as “book reviews”, “editorial”, “editor’s notes”, “letter to the editor”, and “articles in press” were excluded.

Finally, after initial filtering, a search in the database of publishers of target journals (this was done because SCOPUS database might not cover some periods in the selected journals) was also done. A total of fifteen articles with relevant content were selected for further analysis.

4 Findings and Discussion

4.1 Number of Selected Papers Annually

The place of construction output forecast in strategic planning has led to studies aimed at developing reliable and accurate predictive models. The earliest published paper amongst those selected for review was published in 1990. As presented in Figure 1, the number of relevant papers published annually was no more than five for the period under consideration. This reveals that construction output forecasting has not received adequate attention. A plausible reason for this might be non-availability of reliable and adequate data, which is essential for model building.

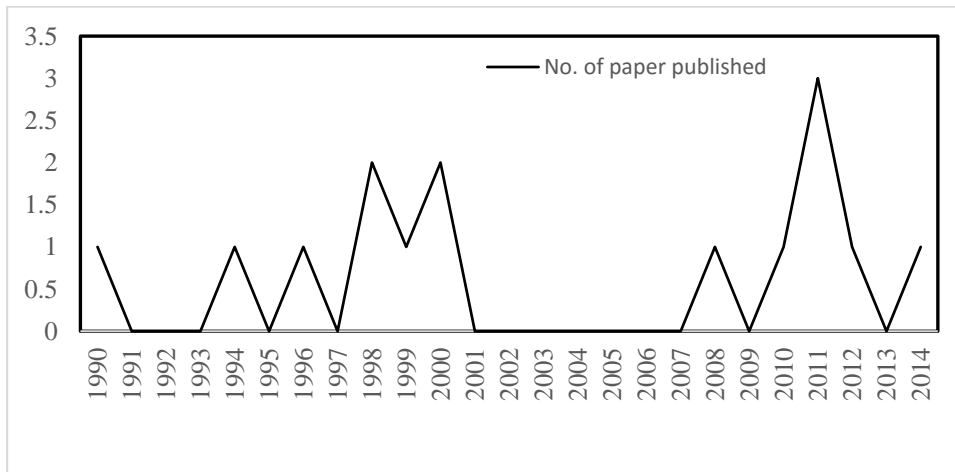


Figure 1. The number of papers distributed annually (from 1990 to 2014)

4.2 Publication Type and Publication Name

In the methods section, the selection criterion was explicitly stated. The search in SCOPUS database and publisher’s database was limited to construction-related journal papers. Table 1 presents the publication names and the corresponding number of published papers. As stated earlier, some of the journals are top-tier construction journals as ranked by Chau (1997), including *Construction Management and Economics* and *Engineering Construction and Architectural Management*. In addition, some leading construction-related journals are also included, such as *Building and Environment*, *Habitat International* and *Australian Journal of Construction Economics and Building*. There were 11 papers from Construction Management

and Economics, which comprises 73% of all the selected papers. This demonstrates the significance of Construction Management and Economics in the field of construction output forecasting.

Table 1. Publication names and the number of corresponding papers (1990-2014)

Journal Title	Number
Construction Management and Economics	11
Engineering Construction and Architectural Management	1
Building and Environment	1
Habitat International	1
Australian Journal of Construction Economics and Building	1

4.3 Country/region Distribution

It should be noted that in some previous reviews (Al-Sharif and Kaka, 2004; Ke et al., 2009), country distribution was related to the location of authors affiliated institution. In this review, this has a different meaning; it focuses on where each study was conducted. Five countries/regions from three continents (except Africa, North and South America) were covered as shown in Table 2. This indicates the global focus of construction output forecast studies. With the exception of Thailand, all these studies were focused on developed countries or regions. This clearly highlights the importance attached to the construction industry and the availability of rich database of construction-related statistics, which aids modelling.

Table 2. The number of relevant papers by country/region

Country	Number
Singapore	5
Hong Kong	4
Australia	3
United Kingdom	2
Thailand	1

4.4 Determinants of Construction Output

The determinants (i.e. independent variables) play an important role in the quality of construction output forecast. Determinants of construction output have been classified based on market segment namely: residential, industrial, commercial, public and overall. The significant determinants used along with the class they belong to are presented in Table 3. There are as many as 34 variables used in different studies. Most of the researchers have utilized theory and stepwise regression in selecting variables used in constructing the respective models. Table 3 shows that a diverse range of independent variables have been used in construction output forecast models. A critical look at the variable used as inputs in the studies selected for this review shows that determinants of construction output are unique, i.e. country and context-specific.

Table 3. Significant determinants of construction output

Explanatory variables	Dependent Variable (Output)				
	Residential	Industrial	Commercial	Public	Overall
Population	TA, G ² , G ³ , G ⁴	G ³			J ¹ , J ²
GDP/GNP/National Income	A, G ¹ , N ^{sw}	A, G ³	A		N ^{fw} , J ¹ , J ² , F ^{NW}
GDP/GNP/National Income per capita	TA, G ¹				
Consumer Price	TA, A, G ¹ , N ^{sw}				
Expansion of industrial capacity		TA, G ³			
Expected profits in manufacturing		TA, A	A		
Government revenue/expenditure/ Public construction output				TA	N ^{fw}
Value added by public utility				TA,	
Interest rate	A, G ¹	G ³	A		J ¹ , J ² , F ^{NW}
Unemployment	G ¹ , G ² , G ³ , G ⁴ , N ^{sw}	G ³	A		N ^{fw} , J ¹ , J ²
Gross Fixed Capital Formation	G ¹ , G ² , G ³				N
Construction material price/Construction tender price index	G ¹ , G ² , G ³ , G ⁴ , F				J ²
Home ownership	G ¹				
Saving (personal/national)/ Purchasing Power	G ¹ , G ² , G ³ , G ⁴	G ³	G ³		J ¹
Property Prices	G ¹ , N ^{sw} , F				J ¹
Labour force	G ¹				
Labour cost		G ³			
Money supply	G ¹	G ³			
Housing stock	G ² , G ³				
Housing loan	G ² , G ³				
Planning approval issued/ Additions to housing stock/	G ⁴ , N ^{sw} , K		G ³		
Land Price			G ³		
Productivity		G ³	G ³		
Sales (retail,)			G ³		
Investment in manufacturing		G ³			
Export price		G ³			
Volume of exports		G ³			J ¹
Exchange rate		G ³			
Leading indicators		G ³			
Availability of Housing loan	G ⁴				
GFCF (residential)	G ⁴				
Gross floor area of development commenced	G ^T				
Hang Seng Index (stock market index)	N ^{sw} ,				
Value of construction work	F	F	F		F

Note: TA= Tang et al. (1990), A=Akintoye and Skitmore (1994); G1 = Goh (1996); N = Notman et al (1998); G2 = Goh (1998); G3 = Goh (1999); G4 = Goh (2000); GT= Goh and Teo (2000); NSW = Ng et al (2008a); F =

Fan et al. (2010); NFW = Ng et al. (2011); FNW = Fan et al. (2011); J1 = Jiang and Liu (2011); K = Karamujic (2012); J2 = Jiang and Liu (2014)

4.5 Construction Output Forecasting Techniques

The complexity, need for accurate forecast and importance of construction output forecast has resulted in the use of several techniques. Based on the classification of forecasting techniques presented earlier, statistical model were the most used techniques in the selected papers, accounting for 79%. The present usage of other techniques: Structural time-series model, Artificial Neural Network and Hybrid models were 4%, 11% and 7% respectively (See Table 4). It is interesting to find that a large majority of the papers used statistical model. This is largely due to its simplicity in use and its ability to estimate the relationship amongst input variables used in the models.

Table 4. Forecasting techniques used in reviewed papers

Author(s) and year of publication	Forecasting techniques	Class of technique	Forecast horizon (in quarters)	Type of forecast
Tang et al. (1990)	MR	SM	40	Ex-ante
Akintoye and Skitmore (1994)	MR	SM	12	Ex-post
Goh (1996)	ANN	ANN	3	Ex-post
	MR	SM		
Notman et al. (1998)	ARIMA	SM	3 and 4	Ex-ante and Ex-post respectively
Goh (1998)	ANN	ANN	5	Ex-post
	ARIMA	SM		
	MLGR	SM		
Goh (1999)	MR	SM	5	Ex-post
	MLGR	SM		
	ARNLR	SM		
Goh (2000)	ANN	ANN	5	Ex-post
	GA-ANN	H		
Goh and Teo (2000)	ARIMA	SM	5	Ex-post
Ng et al. (2008a)	LRA	SM	12	Ex-post
	GA-LRA	H		
Fan et al. (2010)	ARIMA	SM	10	Ex-post
	MR	SM		
Ng et al. (2011)	VEC	SM	10	Ex-post
	MR	SM		
Fan et al. (2011);	VEC	SM	10	Ex-post
	MR	SM		
Jiang and Liu (2011)	VEC	SM	4	Ex-post
	VEC-D	SM		
Karamujic (2012)	Univariate structural time-series model	S	16	Ex-post
Jiang and Liu (2014)	P-VEC	SM	12	Ex-post
	P-OLS	SM		
	MR	SM		

Note: LRA = Linear Regression Analysis, GA-LRA = Hybrid Genetic Algorithms-Linear Regression Analysis

4.6 Accuracy Comparisons

Studies which compare the accuracy of forecasts of construction output generated by various techniques are presented in Table 5. The selected studies were those focused on out-of-sample forecast. The 10 studies presented in Table 6 presented 12 cases of forecast performance comparison. Statistical forecasting models proves to be the most accurate method in 66.7% of the 12 cases. It was observed that non-linear forecasting techniques tend to generate better out-of-sample forecast. Also, back propagation (BP) as the learning algorithm is the most popular choice amongst researchers using ANN for construction output- forecasting problem.

Table 5. Comparison of forecast accuracy

Paper code	Forecasting techniques	Training data (in quarters)	Dependent Variable	Training data (quarters)	Prediction period (quarters)	Level of accuracy (%)	Most accurate technique
G1	ANN	BP	Residential construction	71	3	MPE -0.56 - -1.41 MAPE 1.21 – 1.41	ANN
G2	ARIMA	-				MPE -6.99; MAPE 6.99	
G2	ANN	BP	Residential construction	72	5	MPE 0.38; MAPE 0.93	ANN
G3	ARIMA	-				MPE 0.62; MAPE 1.07	
G3	MLGR	-	Residential construction	72	5	MPE 0.58; MAPE 6.34	MLGR
G3	MLR	-	Residential construction			MPE -5.79; MAPE 9.48	
G3	MLGR	-				MPE 0.58; MAPE 6.34	
G3	ARNLR	-				MPE 7.43; MAPE 7.43	
G3	MLR	-	Industrial construction			MPE 20.67; MAPE 22.42	MLGR
G3	MLGR	-				MPE -13.32; MAPE 20.82	
G3	ARNLR	-				MPE 15.64; MAPE 29.66	
G3	MLR	-	Commercial construction			MPE -58.97; MAPE 58.97	ARNLR
G3	MLGR	-				MPE -18.79; MAPE -18.79	
G3	ARNLR	-				MPE 15.24; MAPE 17.33	
G4	ANN	BP	Residential construction	72	5	MPE 0.15 - 0.36; MAPE 0.87 - 0.93	GA-ANN
G4	GA-ANN	BP				MPE 6.42- 6.92; MAPE 6.42- 6.92	
N ^{SW}	LRA	-	Private housing	48	12	IS 62.68; 127.56	GA-LRA
N ^{SW}	GA-LRA	-		20		IS 34.69	
N ^{SW}	GA-LRA	-		40		IS 31.90	
F	ARIMA	-	Residential construction	87	10	MAPE 4.3	ARIMA
F	MR	-		85	12	MAPE 37.6	
F ^{NW}	VEC	-	Overall construction	90	10	MAPE 2.33	VEC
F ^{NW}	MR	-				MAPE 3.38	
N ^{FW}	VEC	-	Private construction	90	10	MAPE 7.5	VEC
N ^{FW}	MR	-				MAPE 8.1	
J ¹	VEC	-	Overall construction	51	4	U 0.0262; MAPE 3.58	VEC-D
J ¹	VEC-D	-				U 0.0318; MAPE 6.00	
J ²	P-VEC	-	Regional construction	46	12	U 0.0177 - 0.0450; MAPE 2.89 - 5.43	P-VEC
J ²	P-OLS	-				U 0.0304 - 0.1861; MAPE 7.31-11.43	
J ²	MR	-				U 0.0533 - 0.3675; MAPE 9.95 – 20.05	

Note: mean percentage error (MPE); mean absolute percentage error (MAPE); Theil's inequality coefficient (U); Index Sum (IS)

4.7 Discussion and a look into the future of 'construction output forecasting'

Designing of construction output forecast model is a complex task. Variations in significant determinants, forecast horizon, forecasting techniques used, countries/region of study and accuracy assessment have been reported. Although, it was found that statistical models produce most accurate results; this might have occurred due to the over-reliance on such models. It was found that non-linear models (such as ANN, MLGR, etc.) tend to generate more accurate forecast. This was corroborated by the findings of Goh (1999). Marwala (2013) identified the limitation of statistical models to include: linear assumptions, static models, and problems in distinguishing between causality versus correlation. Thus, in order to develop models that can accurately predict construction output, due to its non-linear and complex characteristics. There is a need to further explore the use of non-linear techniques (such as statistical, artificial intelligence and hybrid models) in construction output forecasting research.

The selection of significant determinants (i.e. input variables) is a key issue that affects the success of any forecasting technique. The reliability and adequacy of construction statistics also affects construction output forecast studies. Most studies have used step-wise regression techniques in selecting significant variables for model development. Future studies should consider the use of correlation analysis, principal component analysis (PCA), and similar methods which could further improve performance of out-of-sample forecast.

5 Conclusion and Further Research

It is realized that the reliability and accuracy of construction output forecast can be an effective way to improving planning in the construction industry. The results present a general overview of the trends in construction output forecasting and key issues have been analysed.

In theory several techniques can be used for construction output forecasting; however, in practice just a few of these techniques have been used in empirical literature. The techniques used in construction output have evolved over the last 26 years; it is evident that there have been improvements in model building. One of the interesting findings with respect to statistical models shows that a single model cannot adequately generate forecast for all countries/region/market segment. Hence, it is evident that the construction industry is unique.

Four gaps were identified, namely lack of studies focusing on construction industry in Africa, North and South America; relatively low usage of artificial intelligence techniques despite its ability to adequately capture and forecast non-linearity and complexity associated with construction output data; overlooking of the repair and maintenance sub-sector of the construction industry; and over-reliance on the use of stepwise regression techniques in selecting variables used in model building. Future studies should be targeted at these identified gaps, which will further extend construction output forecasting practice and research.

6 References

- Akintoye, A. and Sommerville, J. (1995). Distributed lag relationships between UK construction orders and output. *Construction Management and Economics*, 13(1), 33-42.
- Akintoye, A. and Skitmore, M. (1994). Models of UK private sector quarterly construction demand. *Construction Management and Economics*, 12(1), 3-13.
- Al-Sharif, F. and Kaka, A. (2004). PFI/PPP topic coverage in construction journals. In: F. Khosrowshahi, *20th Annual Association of Researchers in Construction Management (ARCOM) Conference*, United Kingdom, ARCOM, pp. 711-9.
- Anderson, H.M. and Vahid, F. (2011). VARs, Cointegration, and Common Cycle Restrictions. In Clements M. P. and Hendry, D. F. (eds), *The Oxford handbook of economic forecasting*, Oxford University Press, 9-33.

- Booth, A. (2006). "Brimful of STARLITE": Toward standards for reporting literature searches. *Journal of the Medical Library Association*, 94(4), 421-429.
- Chan, S. (2002). Responses of selected economic indicators to construction output shocks: The case of Singapore. *Construction Management and Economics*, 20(6)523-533.
- Chau, K.W. (1997). The ranking of construction management journals. *Construction Management and Economics*, 15(4), 387-398.
- Egan, J. (1998). *Rethinking Construction*, Construction Task Force, Construction Task Force, Department of the Environment, Transport and the Regions, London, UK.
- Fan, R.Y.C., Ng, S.T. and Wong, J.M. (2011). Predicting construction market growth for urban metropolis: An econometric analysis. *Habitat International*, 35(2), 167-174.
- Fan, R.Y.C., Ng, T.S. and Wong, J.M.W. (2007). A study of forecasting the Hong Kong construction demand. In: W. Hughes (ed). *Proceedings of the Inaugural Construction Management and Economics 'Past, Present and Future' conference*, 16th-18th July 2007, Reading, UK, pp. 865-876.
- Fan, R.Y.C., Ng, S.T. and Wong, J.M.W. (2010). Reliability of the Box-Jenkins model for forecasting construction demand covering times of economic austerity. *Construction Management and Economics*, 28(3), 241-254.
- Goh, B.H. and Teo, H.P. (2000). Forecasting construction industry demand, price and productivity in Singapore: The Box-Jenkins approach. *Construction Management and Economics*, 18(5), 607-618.
- Goh, B.H., (2000). Evaluating the performance of combining neural networks and genetic algorithms to forecast construction demand: The case of the Singapore residential sector. *Construction Management and Economics*, 18(2), 209-217.
- Goh, B.H. (1999). An evaluation of the accuracy of the multiple regression approach in forecasting sectoral construction demand in Singapore. *Construction Management and Economics*, 17(2), 231-241.
- Goh, B.H. (1996). Residential construction demand forecasting using economic indicators: A comparative study of artificial neural networks and multiple regression. *Construction Management and Economics*, 14(1), 25-34.
- Goh, B.H. (2005). The dynamic effects of the Asian financial crisis on construction demand and tender price levels in Singapore. *Building and Environment*, 40(2), 267-276.
- Goh, B. H. (1998). Forecasting residential construction demand in Singapore: a comparative study of the accuracy of time series, regression and artificial neural network techniques. *Engineering Construction and Architectural Management*, 5(3), 261-275.
- Gruneberg, S. and Folwell, K. (2013). The use of gross fixed capital formation as a measure of construction output. *Engineering Construction and Architectural Management*, 31(4), 359-368.
- Jiang, H. and Liu, C. (2014). A panel vector error correction approach to forecasting demand in regional construction markets. *Construction Management and Economics*, 32(12), 1205-1221.
- Jiang, H. Jin, X. H. and Liu, C. (2013). The effects of the late 2000s global financial crisis on Australia's construction demand. *Australasian Journal of Construction Economics and Building*, 13(3), 65-79.
- Jiang, H. and Liu, C. (2011). Forecasting construction demand: A vector error correction model with dummy variables. *Construction Management and Economics*, 29(9), 969-979.
- Karamujic, H. (2012). Modelling seasonality in Australian building approvals. *Australasian Journal of Construction Economics and Building*, 12(1), 26-36.
- Ke, Y., Wang, S., Chan, A.P.C. and Cheung, E. (2009). Research trend of public-private partnership in construction journals. *Journal of Construction Engineering and Management*, 135(10), 1076-1086.

- Koopman, S.J. and Ooms, M. (2011). Forecasting economic time series using unobserved components time series models. In: M.P. Clements and D.F. Hendry, (eds). *The Oxford handbook of economic forecasting*. New York: Oxford University Press, 129.
- Lewis, T.M. (2004). The construction industry in the economy of Trinidad and Tobago. *Construction Management and Economics*, 22(5), 541-549.
- Marwala, T. (2013). *Economic Modeling Using Artificial Intelligence Methods*, Springer: London.
- Ng, S.T., Fan, R.Y.C. and Wong, J.M.W. (2011). An econometric model for forecasting private construction investment in Hong Kong. *Construction Management and Economics*, 29(5), 519-534.
- Ng, S.T., Skitmore, M. and Wong, K.F. (2008a). Using genetic algorithms and linear regression analysis for private housing demand forecast. *Building and Environment*, 43(6), 1171-1184.
- Ng, S.T., Chan, A.P.C., Chiang, Y.H., Kumaraswamy, M.M., Lam, P.T.I., Lee, P.K.K. and Wong, J.M.W. (2008b). *Reinventing the Hong Kong construction industry for its sustainable development* (final report). Hong Kong: Construction Industry Institute.
- Notman, D., Norman, G., Flanagan, R. and Agapiou, A. (1998). A time-series analysis of UK annual and quarterly construction output data (1955-95). *Construction Management and Economics*, 16(4), 409-416.
- Ofori, G. (1993). *Managing construction industry development: lessons from Singapore's experience*, NUS Press, Kent Ridge, Singapore.
- Ofori, G., Hindle, R., and Hugo, F., (1996). Improving the construction industry of South Africa: A strategy. *Habitat International*, 20(2), 203-220.
- Shukla, A., Tiwari, R., and Kala, R. (2010). *Real life applications of soft computing*, CRC Press, Florida.
- Tang, J.C.S., Karasudhi, P. and Tachopiyagoon, P. (1990). *Thai construction industry: Demand and projection*, Routledge.
- Tang, L. Shen, Q. and Cheng, E.W.L., (2010). A review of studies on Public-Private Partnership projects in the construction industry. *International Journal of Project Management*, 28(7), 683-694.
- Weron, R., (2014). Electricity price forecasting: A review of the state-of-the-art with a look into the future. *International Journal of Forecasting*, 30(4), 1030-1081.

FORECASTING CONSTRUCTION DEMAND: A COMPARISON OF BOX-JENKINS AND SUPPORT VECTOR MACHINE MODEL

Lam, Ka Chi; Oshodi, Olalekan Shamsideen; Lee, Eric Wai Ming
Department of Architecture and Civil Engineering, City University of Hong Kong, Hong Kong SAR, China

Abstract

The construction industry provides infrastructure which are needed to drive the process of economic development. Despite its importance, the demand for construction industry's product tends to fluctuate with changes in the economic climate. These unforeseen events have negative impact on the productive capabilities of the construction sector. In order to formulate strategies and policies to minimize the impact of such fluctuations, there is a need to develop predictive models that can reliably and accurately predict such unforeseen events. In the study reported here, two univariate modelling (support vector machine and Box Jenkins) techniques were used to predict demand in the Hong Kong Construction market. The results of predictive accuracy test suggest that the support vector machine (SVM) and the Box Jenkins are both satisfactory for forecasting construction demand. However, the SVM model achieves higher prediction accuracy than the Box Jenkins model. The findings validate the reliability of using artificial intelligence models in predicting construction demand. The findings and robust modelling techniques are valuable to both developed and developing countries when estimating future demand patterns of construction demand.

Keywords: Accuracy, Box–Jenkins model, Construction demand, Forecasting, Support vector machine

1 Introduction

Almost every publication in the field of construction economics have shown that the construction sector plays an important role in the economic development process of any country (see Low and Leong, 1992; Han and Ofori, 2001). The construction sector provides constructed space for economic activities, employment and utilizes goods and services of other sector of the economy during the production process. However, empirical evidence has shown that changes in the macro-economic environment causes fluctuations in the output of the construction industry (Goh 2005; Jiang et al. 2013). In addition, findings from Wong and Ng (2010) shows that Gross Domestic Product, Construction output and tender price are closely correlated. Therefore, the cyclic behaviour of tender price index linked to changes in the economy of Hong Kong (due to Asian Financial Crisis of 1997, Severe Acute Respiratory Syndrome of 2003, etc.) would result in the fluctuations in construction industry's output (hereafter referred to as construction output). Thus, in order to sustain the growth of the economy, constant monitoring of the construction industry is vital.

Cyclic construction output is a problem in both developed and developing countries. This cyclic behaviour creates fluctuations in construction output which has an adverse effect on the construction industry. Fluctuations in construction output leads to employee turnover, loss of

knowledge and experience gained in projects, bankruptcy of construction organisations and increased competition among contractors (Ofori et al. 1996; Lam and Oshodi 2015; Ren and Lin 1996; Soo ad Oo 2014). Also, unplanned expansion of the construction sector due to increase in government investments often fail to achieve intended outcomes. This is evident in the studies reported on Nigerian (Awotona, 1990) and Trinidad and Tobago (Lewis, 1984). Therefore, it has become increasingly important to implement forward planning policies for the construction sector so as to sustain economic growth and avoid economic waste.

Accurate and reliable forecasting of future construction output is crucial to developing strategic long term plans for the construction sector. Goh (1998) asserts that insight into future volumes of construction output will assist stakeholders (such as property developers) to optimize profits. Similarly, governments can use forecast information to develop intervention policies meant to minimize the impact of changes in construction output. Australian government's stimulus plan after the global financial crisis is a good illustration of such government interventions (Jiang et al. 2013). It is evident that reliable forecast of future levels of construction output is crucial for all stakeholders. The aim of the study reported in this paper is to apply two univariate modelling (i.e. Box Jenkins and Support Vector Machine) techniques to forecast future volumes of construction output using Hong Kong as a representative case.

2 Literature Review

The importance of an accurate and reliable construction output forecast has been established in the preceding section. Despite its importance, construction output forecasting research has been limited when compared to studies such as construction cost forecasting. Limited number of studies can be linked to lack of statistical data on construction output, problems in the data collection process and lack of statistical data on other variables that influence construction output (K'Akumu, 2007; Wong and Ng, 2010). To address this problem, studies (such as Gruneberg and Folwell, 2013) have explored the possibility of using construction component of gross fixed capital formation (GFCF) as a proxy of construction output. It was found that construction output, GFCF and the construction component of GFCF are closely related. Though, there might still be a need for further research to validate this finding. The results of Gruneberg and Folwell's study is important to researchers in most developing countries, where data on construction output is largely unavailable. This is because statistical data on GDP and GFCF are reported in most cases to meet the requirements of donor and global funding agencies.

In construction output forecasting literature, there is an evident preference for quantitative modelling techniques. This can be attributed to accuracy and the ability to reproduce forecast generated from this technique when compared with qualitative approaches. Also, construction output forecasting is largely a time series problem (i.e. the relationship between variables in the past are used for future prediction of the dependent variable). Although multivariate models have shown good predictive capability when compared with univariate models (Goh 1996), this finding does not always hold. For instance, Fan et al. (2010) demonstrated that Box-Jenkins (univariate) model outperforms multiple regression (multivariate) model in predicting construction output of Hong Kong. Poor choice of selection of independent variables and the presence of auto-correlated errors have been attributed to inaccurate forecast from multivariate methods (Akintoye and Skitmore, 1994; Killingsworth, 1990). In addition, the application of multivariate modelling techniques is subject to availability of data on explanatory variables. Thus, it is imperative to identify univariate techniques that produce reliable and accurate forecast.

A wide variety of time series modelling techniques have been applied to construction output forecasting problems. Univariate modelling techniques can be grouped into two broad

categories: econometrics (statistical) and artificial modelling techniques. Econometric techniques such as Box-Jenkins was applied to construction demand forecasting for Singapore (Goh and Teo, 2000), Hong Kong (Fan et al., 2010) and the United Kingdom (Notman et al., 1998). Similarly, artificial intelligence modelling techniques have also been applied to construction demand forecasting problems in Singapore (Goh, 2000). Evidences shows that artificial intelligence models tend to produce more reliable and accurate forecast when compared with econometric models (Goh, 1996; Goh, 1998). This can be attributed to the capability of artificial intelligence models (e.g. artificial neural network) to capture nonlinear characteristics of construction demand data. There is little published data on application of support vector machine to construction output forecasting (see Fan et al., 2007). Therefore, this study sets out to apply SVM to predict construction output in the short and medium term. The result of this forecast is compared with those of Box-Jenkins approach which is considered a benchmark as suggested in Goh and Teo (2000).

3 Model Development

3.1 Construction Output

Construction output which measures the volume of construction works by executed main contractors within a defined time frame is collected from the Census and Statistics department of Hong Kong (CSD-HK). In Hong Kong, the construction output time series data is available from CSD-HK between 1983 and 2014 is presented in Figure 1. The cyclic behaviour (i.e. fluctuations) of construction output series appears to be related with changes in the economy and market conditions which shows the effect of the Asian financial crisis of 1997, SARS outbreak of 2003 and global financial crisis experience towards the end of 2008.

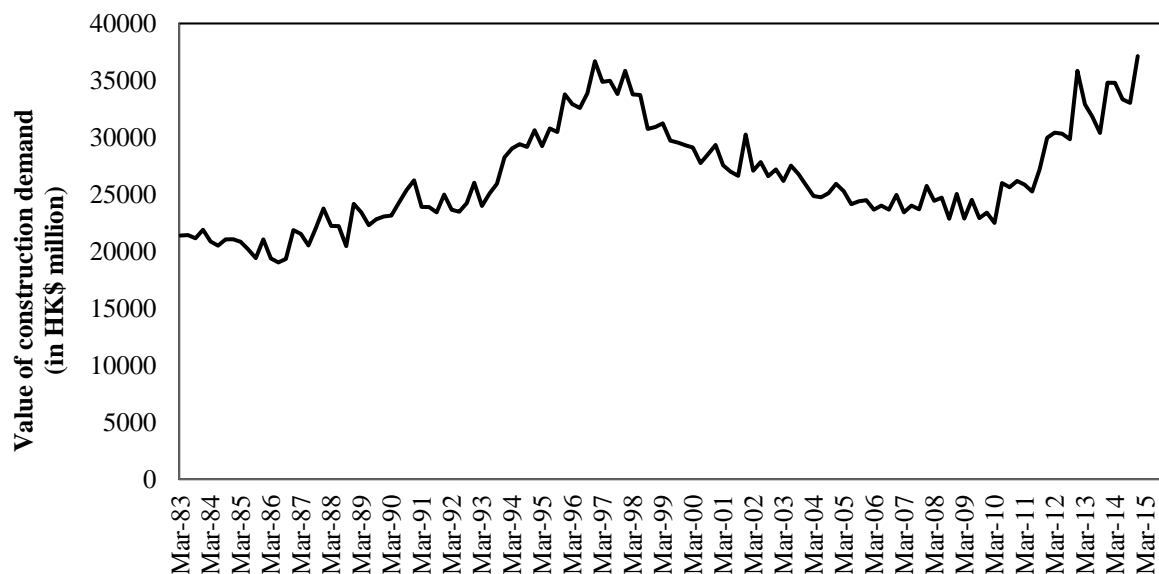


Figure 1. Value of construction demand (data from various years by Census and Statistics Department of Hong Kong)

3.2 Box Jenkins Modelling

Box Jenkins modelling technique is a combination of autoregressive (AR) and moving average (MA) model with differencing which was suggested by Box and Jenkins in 1976. This method is also often referred to as Autoregressive Integrated Moving Average (ARIMA) modelling approach. The process of applying Box Jenkins approach to time series forecasting is an iterative process which involves three major steps: identification, estimation and diagnostic checking, and application. The process is depicted in Appendix 1. The Box Jenkins model is

implemented using the ‘Arima’ code which is part of the forecast package in R programming (Hyndman et al., 2015). Also, the augmented Dickey-Fuller (ADF) and Box-Ljung (referred to as portmanteau) test used in this study are found in ‘urca’ and ‘stats’ package in R, respectively (Pfaff, 2013; R Core Team, 2015). For a detailed explanation on the procedure of fitting time series data to a Box Jenkins model (see Hyndman and Athanasopoulos, 2013).

3.3 Support Vector Machine (SVM)

SVM is an artificial intelligence modelling techniques that has a capability to capture nonlinear behaviour. The SVM algorithm was built based on theoretical foundations found in statistical learning (Vapnik, 1995). Subsequently, this method was later adopted in machine learning and statistics. In addition, SVM has been extensively applied to solving classification and regression problems (see Bin et al. 2006; Lam et al. 2009). This clearly shows that SVM model could be used as a tool for predicting construction output. This is based on the results that emanates from Goh’s (1998) study. The detailed explanation and proofs of SVM can be found in Vapnik (1995) and Vapnik (1998).

The SVM creates a binary classifier, called hyperplane, which maps the input vectors into a high-dimension feature space. Subsequently, the regression problem is solved in the new space. The regression SVM can be represented in the following mathematical form:

$$y = f(x) + b \quad (1)$$

The main task is to identify a functional form (f) which can correctly predict new cases that has not been used to train the model (i.e. test set). The function is estimated by using the Sequential Minimum Optimization (SMO) of an error function (Vapnik, 1995). With the introduction of slack variables (equation 2), the coefficients can be estimated by minimizing the error function of the SVM:

$$\frac{1}{2} w^T w + C \sum_{i=1}^N (\xi_i) + C \sum_{i=1}^N (\xi_i^*) \quad (2)$$

Subject to:

$$\begin{aligned} w^T \phi(x_i) + b - y_i &\leq \varepsilon + \xi_i^* \\ y_i - w^T \phi(x_i) - b &\leq \varepsilon + \xi_i \\ \xi_i, \xi_i^* &\geq 0, i=1, \dots, N \end{aligned}$$

By introducing Lagrangian multipliers which are solvable under Karush-Kuhn-Tucker conditions, the solution of constrained optimization problem is determined. Once the Lagrange multipliers are found, the functional form of the regression SVM model can be expressed as:

$$f(x) = \sum_{i=1}^n (\alpha_i - \alpha_i^*) K(x_i, x_j) + b \quad (3)$$

where, $K(\cdot)$ is the kernel function.

Although other types of kernel functions (e.g. polynomial) exist, the Radial Basis Function (RBF) is used in this study. This can be attributed to its performance and frequency of use in similar previous studies (Bin et al., 2006). In this study, the SVM model was implemented using the SVM with SMO algorithm (named "SMOreg") provided in WEKA (Waikato Environment for Knowledge Analysis) software (Hall et al., 2009). For a detailed explanation on implementing SVM in WEKA, we refer readers to Witten et al. (2011). The process of fitting a SVM model to time series data in this study entailed: dividing collected data into two sets (training and test), import data into the WEKA software, initialize the parameters of the

SVM model, and adjusting of the individual parameters of the SVM algorithm until the adequate parameters are identified.

4 Model Implementation

4.1 Box Jenkins model

Stationarity is critical to applying the Box Jenkins model to time series data, ACF and PACF plots presented in Figure 2 is used to check if the data is stationary. Figure 2 shows that the data is not stationary. The ACF plots gradually die down. Therefore, the first difference is computed and the ACF of the first differenced series is presented in Figure 3. Non-presence of the dying down pattern in the ACF plot suggests that the first differenced series is stationary. ADF test is applied to validate this hypothesis. The ADF shows that the first difference series can be fitted to Box Jenkins model. The parameters of the best fit Box Jenkins model is presented in Table 3-6, the best fit model is selected based on the lowest AICc values as suggested in Hyndman and Athanasopoulos (2013). Subsequently, the residuals of the tentative model are checked for serial correlation. The ACF (Figure 4) and portmanteau test confirms that the residuals are white noise. Absence of serial correlation in the residuals of the final Box Jenkins model indicates the model passed validation test. Thus, the fitted Box Jenkins model is considered adequate. The results of the fitted Box Jenkins model is presented in Table 1. The final form of models for construction outputs is:

Construction output:

$$y'_t = \phi_1 y'_{t-1} + \phi_2 y'_{t-2} + \phi_3 y'_{t-3} + \phi_4 y'_{t-4} + \phi_5 y'_{t-5} \quad (4)$$

where y'_t is $y_t - y_{t-1}$ (construction output variable first-difference); ϕ is the AR coefficient; and ℓ is the random error term (lagged errors).

The out-of-sample forecast generated with the final Box Jenkins model (2013 Q1 -2014Q4) are given in Table 2.

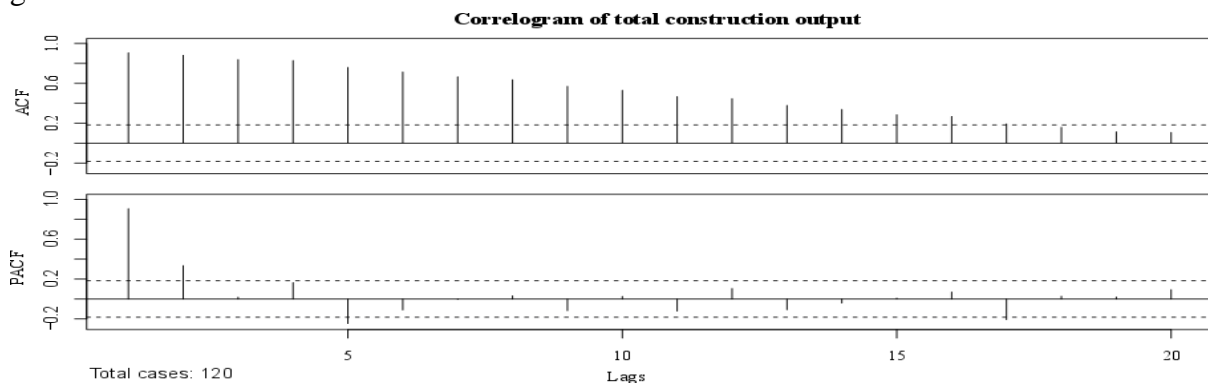


Figure 2. ACF and PACF of ‘construction output’

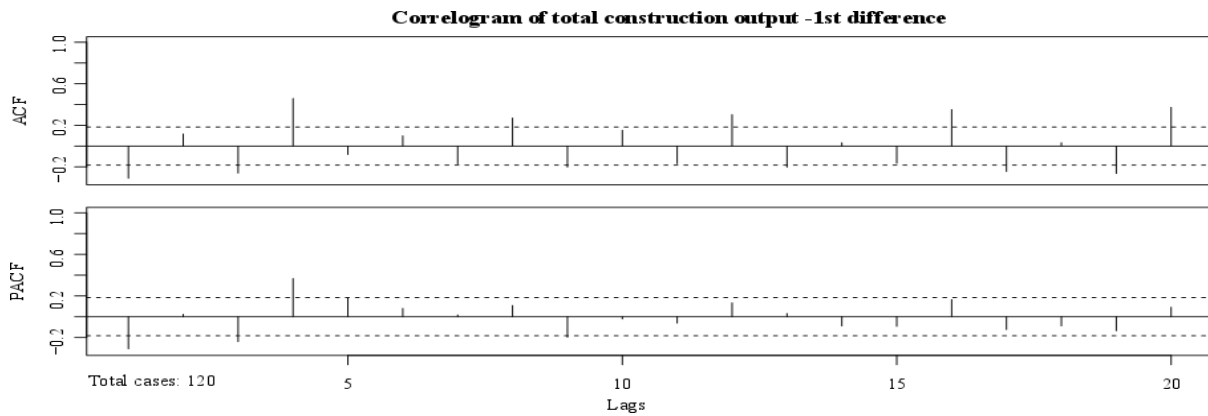


Figure 3. ACF and PACF of first differences of ‘construction output’

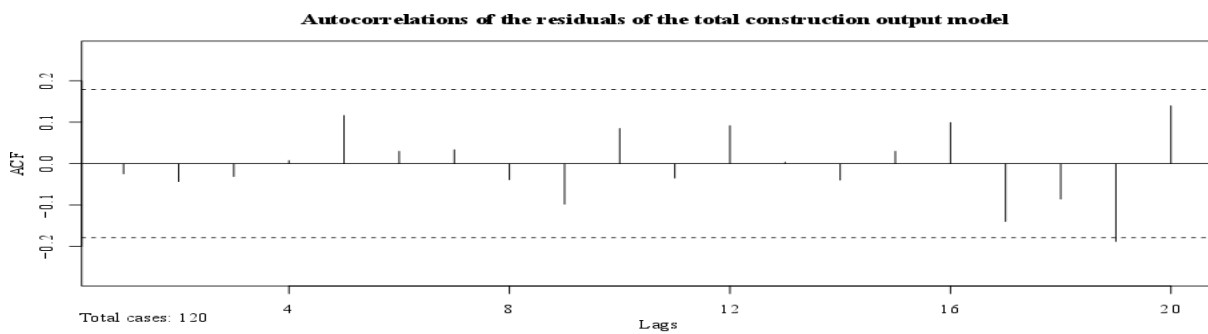


Figure 4. Autocorrelation of residuals of the fitted Box Jenkins (5,1,0) model

Table 1. Estimates of the parameter of the ARIMA (5,1,0) model for total construction output

	AR(1)	AR(2)	AR(3)	AR(4)	AR(5)
Coefficient	-0.2953	0.0003	-0.1205	0.4712	0.2324
Std. error	0.0953	0.0899	0.0889	0.0900	0.0957

4.2 SVM

The parameters of the SVM algorithm used in training the model affects its performance. Although, grid search of the parameter space could give better results, the parameters were manually tuned. This is similar to the approach used in Bell et al. (2012). The optimal parameters used in the SVM model are $(C, \gamma, \text{learning algorithm}) = (32, 0.01, \text{RegSMOImproved})$. The final SVM model is fitted to the data series to produce out of sample forecast (2013 Q1 -2014Q4) which served as a basis for evaluating the accuracy of forecast (Table 3).

4.3 Predictive Accuracy of Forecasting Models

Out-of-sample test is performed to evaluate the predictive reliability of the developed models. SVM and conventional forecasting model (i.e. Box Jenkins), low variance between actual and predicted construction output (in the test data set) signifies better forecasting performance is achieved. In construction output forecasting studies, results of MAPE test that are lower than 10% are considered acceptable. In addition, Theil’s inequality U coefficient value closeness to zero signifies better prediction results is achieved (see Goh and Teo, 2000; Jiang and Liu, 2011 for more detailed explanation and equations).

The actual values and out-of-sample forecast value generated from the Box Jenkins and the SVM model are presented in Table 2 and 3, respectively. Three relative measures of accuracy (PE, MAPE and U coefficient) were used to evaluate the predictive accuracy of the developed

construction output models (Table 4). For both models, the values of MAPE test are less than 10% absolute error and the coefficients U are all close to 0. This indicates that the forecast generated by the models can be considered as satisfactory. In addition, the forecast generated by the SVM model achieved lower MAPE and U values show that the SVM model outperforms the conventional Box-Jenkins approach. Furthermore, the results of the evaluation of predictive accuracy test suggest that the SVM gives a more reliable and accurate forecast of construction demand.

Table 2. Out-of-sample forecast generated by the Box Jenkins model

Period	Actual	Forecast	Error
2013, Q1	32900	34935.04	-2035.04
2013, Q2	31788	35318.22	-3530.22
2013, Q3	30384	34230.43	-3846.43
2013, Q4	34796	37378.05	-2582.05
2014, Q1	34785	37371.05	-2586.05
2014, Q2	33337	37475.28	-4138.28
2014, Q3	33031	36641.74	-3610.74
2014, Q4	37132	38119.21	-987.21

Table 3. Out-of-sample forecast generated by the SVM model

Period	Actual	Forecast	Error
2013, Q1	32900	33910.8	-1010.8041
2013, Q2	31788	34178.24	-2390.2443
2013, Q3	30384	33895.57	-3511.5739
2013, Q4	34796	34831.98	-35.9831
2014, Q1	34785	33835.98	949.0157
2014, Q2	33337	33700.58	-363.5812
2014, Q3	33031	33245.3	-214.3005
2014, Q4	37132	32884.02	4247.9842

Table 4. Summarized results of evaluating predictive accuracy

Period	Box Jenkins Model	SVM model
PE for 2013, Q1	-6.19	-3.07
PE for 2013, Q2	-11.11	-7.52
PE for 2013, Q3	-12.66	-11.56
PE for 2013, Q4	-7.42	-0.10
PE for 2014, Q1	-7.43	2.73
PE for 2014, Q2	-12.41	-1.09
PE for 2014, Q3	-10.93	-0.65
PE for 2014, Q4	-2.66	11.44
MAPE	8.85	4.77
U	0.0440	0.0324

5 Discussion, Conclusion and Further Research

Construction demand forecasting is vital to the development of strategic future plans for the construction sector. Previous studies have demonstrated that the Box Jenkins model can be used to predict demand, productivity and prices in the construction market (Goh and Teo, 2000; Fan et al., 2010). However, it has been found that construction demand exhibit nonlinear characteristics. This suggests nonlinear models (such as SVM) possess the capacity to generate reliable and accurate predictions of construction demand. The main purpose of the current study is to compare two univariate modelling techniques (Box Jenkins and SVM), in order to identify and assess the predictive capability of both approaches. The out-of-sample forecast

generated between first quarter of 2013 and fourth quarter of 2014 served as a basis for evaluating the predictive performance of these two models.

The high predictive accuracy achieved by the SVM model when compared with Box Jenkins model (Box Jenkins model is considered as a benchmark for univariate model as suggested in Goh and Teo, 2000). This indicates that the SVM model can reliably and accurately forecast construction demand in Hong Kong. In addition, the finding indicates that artificial intelligence models (SVM) tend to outperform linear models. These results are in agreement with those obtained by Goh in 1998. Though previous studies (such as Goh and Teo, 2000) suggest that Box Jenkins model might not be suitable for medium and long-term forecast, one unanticipated finding was that the Box Jenkins model could generate satisfactory forecast for 8-quarters ahead. A possible explanation for this might be the relative stability of the construction demand data series in the forecast period. In general, therefore, it seems that artificial intelligence models (such as SVM) can be applied to construction demand forecasting problems under different circumstances.

The major limitation to this study is the absence of other explanatory variables in the developed models. Despite this limitation, the intended objective of the study was achieved. It is worth noting that the univariate modelling techniques applied in the current study could be useful in cases of limited data which affects the possibility of developing large multivariate models. The findings from this study enhance the knowledge on the applicability of univariate modelling techniques to construction demand forecasting problems. Overall, the SVM model developed in this study can be used as a tool for predicting future volume of construction demand. Reliable forecast of construction demand is vital for developing and implementing strategies to minimize the adverse impact of fluctuating demand.

6 References

- Akintoye, A. and Skitmore, M. (1994). Models of UK private sector quarterly construction demand. *Construction Management and Economics*, 12(1), pp.3–13.
- Awotona, A. (1990). Nigerian government participation in housing: 1970-1980. *Habitat International*, 14(1), pp.17–40.
- Bin, Y., Zhongzhen, Y. and Baozhen, Y. (2006). Bus Arrival Time Prediction Using Support Vector Machines. *Journal of Intelligent Transportation Systems*, 10(4), pp.151–158.
- Census and Statistics Department (various years), *Report on the Quarterly Survey of Construction Output*, Census and Statistics Department, the HKSAR Government, Hong Kong.
- Fan, R.Y.C., Ng, S.T. and Wong, J.M.W. (2010). Reliability of the Box-Jenkins model for forecasting construction demand covering times of economic austerity. *Construction Management and Economics*, 28(3), pp.241–254.
- Fan, R.Y.C., Ng, T.S. and Wong, J.M.W. (2007). A study of forecasting the Hong Kong construction demand. In: W. Hughes (ed). *Proceedings of the Inaugural Construction Management and Economics 'Past, Present and Future' conference*, 16th-18th July 2007, Reading, UK, pp. 865-876.
- Goh, B.H. (1999). An evaluation of the accuracy of the multiple regression approach in forecasting sectoral construction demand in Singapore. *Construction Management and Economics*, 17(2), pp.231–241.
- Goh, B.H. (1998). Forecasting residential construction demand in Singapore: a comparative study of the accuracy of time series, regression and artificial neural network techniques. *Engineering Construction and Architectural Management*, 5(3), pp.261–275.
- Goh, B.H. (1996). Residential construction demand forecasting using economic indicators: A comparative study of artificial neural networks and multiple regression. *Construction Management and Economics*, 14(1), pp.25–34.

- Goh, B.H. (2000). Evaluating the performance of combining neural networks and genetic algorithms to forecast construction demand: The case of the Singapore residential sector. *Construction Management and Economics*, 18(2), 209-217.
- Goh, B.H. (2005). The dynamic effects of the Asian financial crisis on construction demand and tender price levels in Singapore. *Building and Environment*, 40(2), pp.267–276.
- Goh, B.H. and Teo, H.P. (2000). Forecasting construction industry demand, price and productivity in Singapore: The Box-Jenkins approach. *Construction Management and Economics*, 18(5), pp.607–618.
- Gruneberg, S. and Folwell, K. (2013). The use of gross fixed capital formation as a measure of construction output. *Construction Management and Economics*, 31(4), pp.359–368.
- Han, S.S. and Ofori, G. (2001). Construction industry in China's regional economy, 1990-1998. *Construction Management and Economics*, 19(2), pp.189–205.
- Hall, M., Frank, E., Holmes, G., Pfahringer, B., Peter, R. and Witten, I. H. (2009). The WEKA data mining software: *an update*. *SIGKDD Explorations*, 11(1), pp. 10-18.
- Hyndman, R.J., Athanasopoulos, G., Razbash, S., Schmidt, D., Zhou, Z., Khan, Y., Bergmeir, C. and Wang, E. (2015). *Package forecast: Forecasting functions for time series and linear models*, available at: <http://cran.r-project.org/web/packages/forecast/forecast.pdf> (accessed 09 March 2015).
- Hyndman, R.J. and Athanasopoulos, G. (2013). *Forecasting: principles and practice*, OTexts, available at: www.OTexts.com/fpp (accessed 08 January 2015).
- Hyndman, R.J. and Koehler, A.B. (2006). Another look at measures of forecast accuracy, *International Journal of Forecasting*, 22 (4), pp. 679-688.
- Jiang, H., Jin, X.-H. and Liu, C. (2013). The effects of the late 2000s global financial crisis on Australia's construction demand. *Australasian Journal of Construction Economics and Building*, 13(3), pp.65–79.
- Jiang, H. and Liu, C. (2011). Forecasting construction demand: A vector error correction model with dummy variables. *Construction Management and Economics*, 29(9), pp.969–979.
- K'Akumu, O.A. (2007). Construction statistics review for Kenya. *Construction Management and Economics*, 25(3), pp.315–326.
- Killingsworth, R.A. (1990). Preliminary investigation into formulating a demand forecasting model for industrial construction. *Cost Engineering*, 32(8), pp.11–15.
- Lam, K.C. and Oshodi, O.S. (2015). The capital budgeting evaluation practices (2014) of contractors in the Hong Kong construction industry. *Construction Management and Economics*, 33(7), pp.587–600.
- Lam, K.C., Palaneeswaran, E. and Yu, C. (2009). A support vector machine model for contractor prequalification. *Automation in Construction*, 18(3), pp.321–329.
- Lewis, T.M. (1984). A review of the causes of recent problems in the construction industry of Trinidad and Tobago. *Construction Management and Economics*, 2(1), pp.37–48.
- Low, S.P. and Leong, C.H.Y. (1992). A revisit to Turin's paradigm. Construction and development in the 1970s and 1980s. *Habitat International*, 16(3), pp.103–117.
- Notman, D., Norman, G., Flanagan, R., and Agapiou, A. (1998). A time-series analysis of UK annual and quarterly construction output data (1955-95). *Construction Management and Economics*, 16(4), pp.409–416.
- Ofori, G., Hindle, R. and Hugo, F. (1996). Improving the construction industry of South Africa: A strategy. *Habitat International*, 20(2), pp.203–220.
- Pfaff, B. (2013). *Package urca: Unit root and cointegration tests for time series data*, available at: <http://cran.r-project.org/web/packages/urca/urca.pdf> (accessed 09 March 2015).
- R Core Team (2015). *R: A language and environment for statistical computing*, R Foundation for Statistical Computing. Vienna, Austria, available at: <http://www.R-project.org/> (accessed 02 February 2015).

Ren, H. and Lin, S.S. (1996). The UK construction industry under cyclical high inflation, high interest rates and recession. *International Journal of Project Management*, 14(5), pp.301–305.

Soo, A. and Oo, B.L. (2014). The effect of construction demand on contract auctions: an experiment. *Engineering, Construction and Architectural Management*, 21(3), pp.276–290.

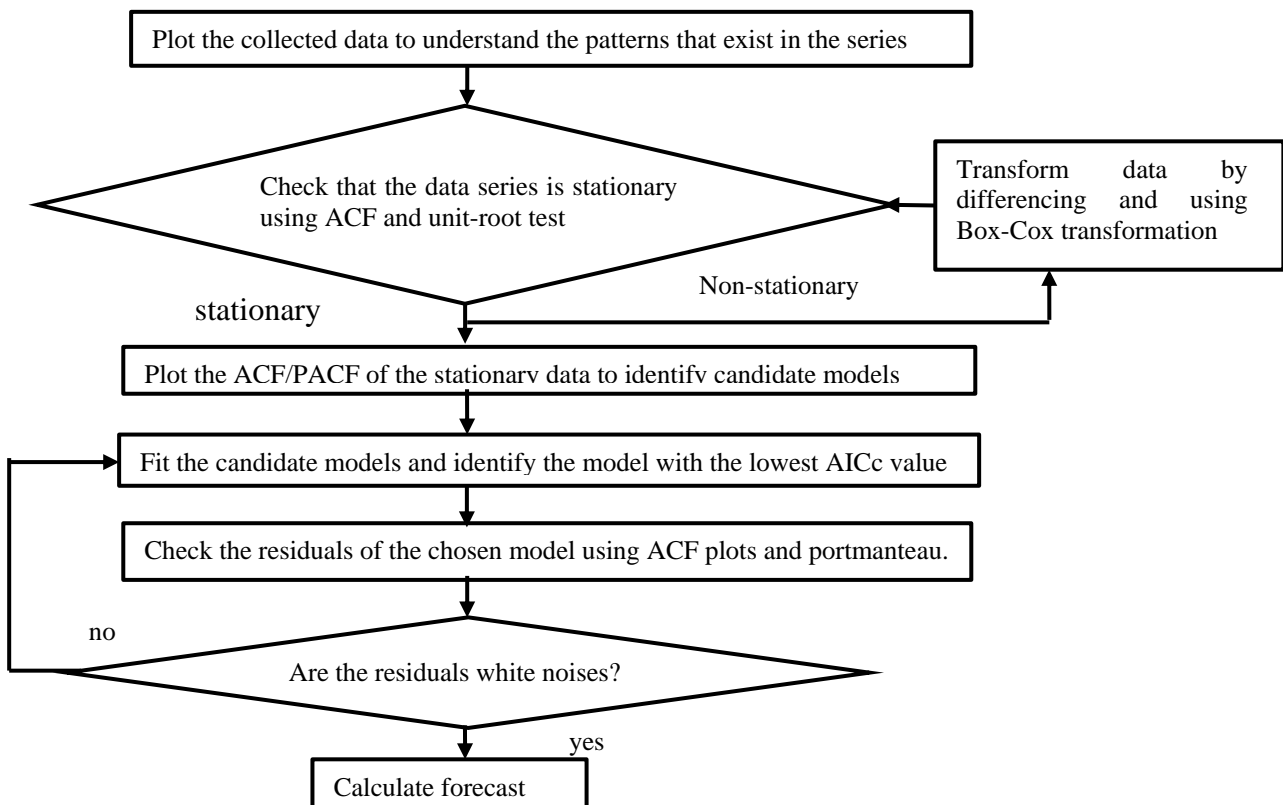
Vapnik, V. (1998). *Statistical learning theory*, New York.

Vapnik, V. (1995). *The Nature of Statistical Learning Theory*, New York: Springer.

Witten, I.H., Frank, E. and Hall, M.A. (2011). *Data Mining: practical machine learning tools and techniques*, 3rd edn. Morgan Kaufmann Publishers, Burlington, MA.

Wong, J.M.W. and Ng, S.T. (2010). Forecasting construction tender price index in Hong Kong using vector error correction model. *Construction Management and Economics*, 28(12), pp.1255–1268.

Appendix 1 Process of fitting a Box-Jenkins model (Adapted from Hyndman and Athanasopoulos, 2013)



MODELING THE RELATIONSHIP BETWEEN THE INITIAL TENDER SUM, DURATION AND FINAL CONSTRUCTION COST OF BUILDING PROJECTS IN NIGERIA: A PROPOSED STUDY

Oboirien, Momoh Ohiomah

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, South Africa

Abstract

Cost and time overruns have instituted a high level of discredit and stigmatization on the construction industry professionals. This is an issue that should task built environment practitioners. While accepting the challenges of project overruns as emerging negative trend in construction industries, the aim here is to propose solutions to the problems by investigating the variability, with a view of relating all the variables together in a single equation. The derived relationship is intended for use in constructing final cost predictive models or charts for building constructions. The objectives include; studying 420 completed buildings and extracting the variables, plotting graphs of costs against times, to establish a relationship. In addition, 1050 project officers shall be interviewed across Nigeria’s six geo-political zones and Abuja the federal capital territory to source for other data to complement those from files. Artificial Neural Network system shall be used for analysis leading to the models/charts design. The derived models/charts would serve as formulae/graphs for predicting future cost of building projects. The research outcome shall be a solution to the growing negative trend of wide variability between the targeted and those achieved. The models/charts shall be tools for construction planning and cash flow projections. This invariably shall be instruments for reducing building project abandonments which major reason has been sudden upsurge in construction funds requirement.

Keywords: Cost, Modeling, Predictive, Relationship, Variability

1 Introduction

Tender sum is the estimated cost of building project at the conclusion of tender meetings and award. In all systems of contract, the as-built cost (final cost) is always determined at completion stage (Hammad *et al.*, 2008). The only exception is fixed or firm price contract for which the initial tender sums cannot be altered; i.e., the final construction cost remain same although the project stages. Construction cost overrun is a major problem faced by the industry globally and it needs serious attention to alleviate (Rahman *et al.*, 2013). Otunola (2008) and Rowland (1981) in Vidalis and Najafi (2002) explain cost and time overruns as the excess amount of money/time over the original contract sum/time. They negate the projected budgets, and account for numerous abandoned projects that litter parts of the world (Hachney, 1997 in Otunola, 2008: and Amusan *et al.*, 2013b). Variables like material price inflation, work additions and subtractions, changes in policy and fiscal measures, corruption (kickbacks), etc. usually come to play during project execution. Otunola (2008) grouped these variables into ten

and ranked them in order of severity in Nigeria construction industry, inflation ranked highest while underpricing the bills of quantities is least. Rahman *et al.*, (2013) ranked contractor's poor site management highest among the factors in Malaysia. Ugulu & Ikwuogu (2011) affirmed that as the project takes longer to complete, effects of fluctuation are more pronounced especially in an unpredictable and inflationary economy like Nigeria's. They also affirmed that bigger and more complex building projects attract more variations. Managing these variables so as not to have wide deviations from the planned, becomes a major activity of the contractual parties. Inability to manage the project to equate tender sum with final cost voids a major objective of cost control. Since changes in the initial and final figures are not limited to one project, or to one nation, relationship seems to exist between the variables which are: final cost of construction, extensions, resources' price galloping, work changes, daywork, provisional and prime cost sums inadequacies, corruption; etc.

1.1 The Research Gap

Gonzalez (2007) investigated the possibility of using fuzzy mathematical models for construction project scheduling; the results are relevant practically to the construction industry. Analysis of Amusan *et al.*, (2013b) presents preliminary validation of prospect of obtaining a model that would predict building construction cost with minimum error, this also demonstrates the applicability of neural network in forecasting the cost of building work. The NIOB (2002) attributed among others the causes of time and cost overruns in Nigeria to the consequence of not engaging the services of professional builders at the design stages or not early enough even when engaged. The professional institution advocates the engagement of Builders who use Building Production Management Document (Construction Methodology Statement/Construction Plan) to nip in the bud the current trend of time and cost variability. NIOB (2002) document went further to stress that construction programmes hitherto used on Nigerian sites are either too long or short for the projects. This is also the view of Aiyetan *et al* (2012) in South African construction industry, the authors described the targeted completion times as always inaccurate. The conclusion of the NIOB is that they are inaccurate because they are not always prepared by professional builders. Could it be said, all over the world, that construction programmes are prepared by quacks, since the Institute says non-professional builders who prepare programmes are into quackery? Solutions hitherto proffered for solving the variability issue and cost control had not provided cost predictive formulae or charts for construction project as envisaged in this work. The gap of unavailable mathematical formulae or charts for cost prediction at commencement stage is yet to be filled in the building construction industry i.e., cost variability seems **not** to have been reasonably dealt with from several research findings across the globe such as (Azis, *et al.* 2013; Bamile, 2004; Edwards, 2009; Gandu, 2014; Idoro, 2012 and Odeyinka, *et al.* 2012). A number of scholars had worked on issues of time and cost overruns including Odediran and Windapo (2014), the focuses were on the causes. Moreover, time and cost variability are studied separately. This work intends to fill this gap in the construction industries particularly in Nigeria.

1.2 Aim and Objectives

The research seeks to assess the relationship between the tender sum, initial contract duration, extensions and final construction duration/cost of building projects in Nigeria with a specific objective of generating final cost predictive models or charts. The objectives therefore shall be to;

- (i) Investigate the average percentage time and cost variability for building projects.
- (ii) Survey a sample of completed building projects and extract the contract durations, tender, additional costs/times in course of construction and final construction time and

cost, plot graphs of the cost against duration and hence, the angles of inclination to the horizontals.

- (iii) Establish the mean of all the angles of inclination to the horizontals (α), test for any relationship between the variables by the use of regression analysis.
- (iv) Build final cost predictive model(s) or chart(s) from the relationship.
- (v) Test the models for reliability.

1.3 The Research Questions

Questions to be answered in this work are:

- (i) What is currently the average percentage time and cost variability for building projects in Nigeria? Analysis of variance (ANOVA) is most suitable among the available statistical tools for answering this question.
- (ii) What is the relationship between the tender sum, the intervening variables of time and cost; with respect to final construction duration and cost of building projects i.e. is there a trend? This can be answered with the use of Regression Analysis.
- (iii) What mathematical formulae (models) could be developed from the trend for use in predicting final construction cost of projects with respect to the initial tender sum, the intervening costs and time extensions, project initial completion target date and final durations? Artificial Neural Network (ANN) is a most suitable tool for exploring the possibility.
- (iv) What charts could be developed from the trend that would serve as tools for predicting final cost of building projects from the tender sums and other variables? Artificial Neural Network (ANN) is also most suitable tool for exploring the possibility.

According to Morenikeji (2006) model specification as a process of identifying and operationalising suspected variables that best explain the phenomenon being modeled. Keeling and Rohani (2008) numerous scientific computer packages permit quite sophisticated modeling, such as Mathematica, Maple R, MathCAD, and Matlab. Given ($t \tan \alpha$) as the *mean* from a number (n) of past projects a relationship is therefore established (see equation 5), cost predictive model which this research is proposing could be derived by operating on equation 6.

$$FCC_{t_n} = ICS_{t_0} + \sum(ADC_{t_1} + ADC_{t_2} + ADC_{t_3}) \dots \dots \dots e q (1)$$

Where; FCC_{t_n} = final construction cost at time t_n .

ICS_{t_0} = initial tender sum.

$$\sum(ADC_{t_1} + ADC_{t_2} + ADC_{t_3}) = \text{additional costs arising at project execution stage at differing points of time} \dots \dots \dots e q (2)$$

Similarly;

$$FCD_{t_n} = ICD_{t_0} + \sum(ADT_{t_1} + ADT_{t_2} + ADT_{t_3}) \dots \dots \dots e q (3)$$

Where; FCD_{t_n} = final construction duration at time t_n

ICD_{t_0} = initial construction duration set at award stage

$$\sum(ADT_{t_1} + ADT_{t_2} + ADT_{t_3}) = \text{secured construction time extensions on work items} \dots \dots \dots e q (4)$$

Combined variables (additional works and time extensions) that influence the initial tender sum.

$$\sum(ADC_{t_1} + ADC_{t_2} + ADC_{t_3}) \dots \dots \dots \} = t \tan \alpha \dots \dots \dots e q (5)$$

$$\sum (ADT_{t1} + ADT_{t2} + ADT_{t3})$$

Equation (5) establishes the value of all variables that shoot tender sums to a certain final cost.

The **desired model** tentatively put **as equation 6** can be operated upon mathematically for standardizations; $FCC_{tn} = ICS_{t0} + ICD_{t0} + t \tan \alpha \dots\dots\dots e q (6)$

Analysis of field data hopefully shall focus on the predictive model.

1.4 The Research Hypotheses

Null **H₀** – There is no relationship between the initial tender sum, targeted duration, extensions and final construction cost of building projects.

Alternate **H₁** – There is a relationship between the initial tender sum, targeted duration, extensions and final construction cost of building projects.

1.5 Need for the Research

Actual or final project costs need not be too wide in deviations from the planned and uncertain to clients and project consultants, otherwise projects get revised when resources needed to complete them overshoot the budget. Moreover the result could be abandonment, where were no provisions for supplementary. In the case of capital projects, which costs at inception, are most likely to change with work progress, and because forces beyond the control of the contractual parties definitely come to play, formulae/models are needed as a guide (indicator) to what the initial cost will change to, with respect to time. This is vital for healthy, effective and efficient budgeting for an agency like the Nigeria Budget Monitoring and Price Intelligence Unit (BMPIU) now Bureau of Public Procurement (BPP). One of the policy objectives of BPP is funding the projects that were duly certified in annual appropriations by the National Assembly (State House, 2005). This implies that estimates for goods and services are pegged at periods prior to tendering and contract award stages. If the policy must be sustained, and if projects are to be completed within budgets (a major project success criteria), the use of a predictive tool like that envisaged from this study shall be relevant to BPP, other corporate clients and even private individuals in capital project financial planning.

2 Project Success Criteria

The achievement of the targeted cost, time and quality in a construction project has remained the success rating tools among construction professionals and clients, Atkinson (1999) label these criteria as the “iron triangle”. Baccarini and Collins (1999) notes that the traditional project management success criteria still hold strong within the project management community in Australia. According to Duggal (2015) project managers are expected to manage the triple constraints and often compelled to live in this triangle of time, cost and quality. Although it is a way to track and monitor projects, many scholars like Atkinson (1999) now view the triple criteria as not sufficient, insisting that there is more to project success than meeting time, cost and quality. According to Atkinson (1999) other success criteria include; the information system, organizational benefits and stakeholder community benefits. Together with the iron triangle they are tagged the “square route”. Notwithstanding, the iron triangle seems to continue to be the preferred success criteria.

2.1 Construction Project Cost Analysis and Control Procedure

Seeley (1976) define cost analysis (cost to the client), as the systematic breakdown of the cost according to the sources from which they arise. This means the tender sum of a project can be broken into elemental costs. Cost control, embarked upon at execution stage aims at ensuring that resources are used to the best advantage. Cost analysis is the basis of cost control.

Cost control process ideally is continued from tender stage through to the construction period by the Quantity Surveyor to ensure that the cost of the building is kept within the agreed cost limit. When work on site commenced, cost analysis is used for controlling variation. Priced bills of quantities, schedules of basic, insurances and other relevant documents are scrutinized, suitable arrangements for dealing with daywork vouchers and claims for increased costs are agreed with the contractor. Accurate record of drawings is maintained with revisions noted and costed, variation orders costed and filed. On site visits for measurements and interim valuations, matters such as labour strength, plant in use, weather conditions and causes of delay, which may subsequently have a bearing on claims, are noted. Throughout the contract period the Quantity Surveyor maintains effective cost control arrangements to keep a constant check on the costs and supplies advice to the project Architect for action to be taken without adverse effects on the project cost.

The foregoing professional duty of the Quantity Surveyor at controlling building construction cost notwithstanding, construction project still terminate at figures above the target. In most cases, plans are hardly made for such uncertain extra fund to complete the project. What industrial damages this inflicts, together with the solution is the concern of this study. Hitherto, researchers are yet to proffer quantitative mechanism(s) for relating the terminal cost to that in the bills of quantities at pre-contract stage. The results of this study hopefully shall be relevant to Quantity Surveyors and Clients for predicting the final construction cost at for use in cash flow planning.

2.2 Combine Effects of Time and Cost Overruns on Final Construction Cost

Hasan *et al.* (2014) submit that cost and time overruns are two most frequent effects of project delay. Completion time the authors posit is very essential in construction; because “time is money”. To the contractor, delay causes higher overhead costs because of longer construction period, material costs may increase due to inflation. To the client especially the investor, delay means losing profits. Delays translate always into expenses for the period lost, while materials may not be lost in the period of work hold-ups except when stolen. Delays are funded and this adds to the initially set contract sum. Where additional jobs were duly approved for executions, automatically extra times are required for the extra works. Effects of cost of varied works and delays are interwoven, they both cause increase to the construction cost, or a decrease which in most cases is rear. Studies on time and cost overruns conducted separately would not have much practical relevance to the industry, as it is currently.

2.3 Cost of Delivery Public Infrastructures in Nigeria

Nnorom (1998) discovered cost differences in completed building projects in the study of the effects of variations on project final costs. One of the most highlighted of the findings is that, in the Nigerian Construction Industry, almost all projects are being completed at sums much higher than their initial contract sums. For instance, the Amenity Hospital Kaduna originally awarded at ₦1.25 Million had a projected final account of ₦2.00 Million, an increase of about 63%. Also, the Specialist hospital in Minna, Niger State originally awarded at initial contract sum of ₦17 Million was rewarded to the same contractor at ₦40.50 Million, an increase of 138%. Furthermore, the Presidential Lodge Abuja originally awarded at about ₦20 Million was revised to ₦35 Million, an increase of 75%. More so in Zaria, the contract for the new office complex for the Nigeria Institute of Transport and Technology (NITT) was awarded at a cost of ₦14.50 Million in 1983. However it was reviewed to a cost of ₦31 Million in 1986 and again to ₦100 Million in 1989. Giwa (1988) in Nnorom (1998) noted an overall increase on initial contract sum of 36.02% on ninety (90) completed projects. Analysis of the various final account statements of some of these projects attributed the increases to: fluctuation

10.20%, variation 8.43%, PC sums 5.98%, re-measurement 0.50%, provisional sums 1.37% and others 2.28 % (Nnorom, 1998, p. 2).

3 Research Methodology

Primary data shall be collected through the examination of files of completed projects in the offices of registered Quantity Surveyors across Nigeria's six geo-political zones together with the federal capital territory, Abuja. Corporate and organized private sector clients shall also be visited for collection of data pertaining to the variables. Cluster sampling is a technique suitable for surveys involving natural groupings in a statistical population. The advantage of cluster sampling method is economizing on traveling expense for data sourcing for researches involving geographical area. Six (6) state capitals shall be visited in each of the six (6) geo-political zones and Abuja to study ten (10) projects files in each state. This means sixty (60) completed projects per zone making a total number of 420 completed projects. Also 1050 respondents across the zones i.e. 150 in each geo-political zone including Abuja shall be interviewed to source data that will not be possible to extract from project files. Designed templates for recording data shall be used for the files studies. Interview guide designed with considerations for confidentiality of data involved shall be used, so as not to scare respondents from giving full supports in the provision of relevant data. Space for sourcing the biographical data of respondents shall be created on the guide to enhance the assessment of respondents' professional background, experience and reliability of the data sourced. The interviews with project officers shall focus on sourcing data on type and number of professionals that were involved in the design as well as the contract documents (production information) used in executing the projects. Collected data shall be presented in Tables, Figures and Charts with respect to the research aim and objectives.

3.1 Analysis of Variance (ANOVA) and Artificial Neural Network (Expert System)

According to Agbola *et al.* (2013) and Kirk (2008) the method for testing the difference among k means (n) where $k > 2$, is Analysis of Variance (ANOVA). This technique shall be used for testing the hypothesis that the means (n) for time and cost overruns of the seven zones are equal at 5% confidence level. If differences exist among the means (n), ANOVA also shows the zone and the zonal difference.

Series of modeling framework had been adopted in the past which are regression based (Amusan, *et al.* 2013a). Efforts in research Amusan *et al.* (2013a) maintained are now directed towards validating the applicability of the developed models. Mawdesley *et al.* (1999) and Asworth (1994) in Amusan *et al.* (2013a) present approaches in modeling; elemental, regression, heuristics and expert system (artificial neural network). Molenaar *et al.* (2000) in Rahman *et al.* (2013) regard Structural Equation Modeling (SEM) as an extension of standardized regression modeling used in dealing with poorly measured independent variables and is ideally suited for many research issues in the field of construction engineering and management. Yang and Ou (2008) and Ng *et al.* (2010) in Rahman *et al.* (2013) state that the SEM method is suitable for exploring relationships among key variables and is highly applicable for resolving the complicated problems in the construction domain as the functionality of SEM is better than other multivariate techniques including multiple regression path and factor analysis. In the context of engineering and management SEM is still new (Henseler *et al.* in Rahman *et al.*, 2013). Therefore this study will not explore further the use of PLS-SEM in data analysis because of its relative newness to construction and engineering fields, the advantages notwithstanding. Regression based models are also found to be limited in application as a result of non-flexibility and margin of error between input and output. The system also relies on historic cost and has its short comings which include; inability to capture

intervening variables that impact project, such as price change, inflation change among others (Moore *et al.*, 1999 in Amusan, *et al.*, 2013a).

Paradigm need to be shifted in the direction of conventional method that complements the regression method's shortcomings as case based reasoning and expert system. Expert system are patterned after the neural biological neurons with the ability to map input to output and deduct a meaningful inference, it possess capability of studying data trend even if the series is inconsistent. Once the pattern is mastered, the network can generalize the trend to predict a consistent series having mastered the previous trend. Expert system's attributes include; capacity to accommodate large data input, consistent output, output and input mapping, low variation error between input and output. Expert-based system generates less error between input and expected output, it tends to have variation error within the range of 2% to 4% while regression model often have variation error greater than 7%, (David and Seer 2004; Dissanayaka and Kumaraswamy 2007 and Moore *et al.*, 1999 in Amusan *et al.*, 2013a). A robust expert-based model (ANN) incorporates economic and environmental parameters capable of generating accurate project cost. According to Aigbomian and Momoh (1996); Egbule and Okobia (1998) in Idogho (2001) research is act of consciously organizing oneself to solve a given problem with the specific aim of improving on the existing standard, for greater comfort and convenience resulting in contribution to knowledge. Halmatadlefs (1970) in Iredia (2003) defined research as an activity of solving problems which leads to new knowledge using methods of inquiry which are currently accepted as adequate by scholars in the field. The weakness of correlation/regression analysis to capture intervening variables such as, works delay due to inclement weather, daywork, material and labour price rise which are peculiar to construction activities coupled with these definitions of research, shift the anticipated analytical technique to ANN. The relationship between the variables shall therefore be investigated with regression analysis and expert-based system (Artificial Neural Network ANN) explored for predictive cost model construction.

4 Expected Research Findings and Usefulness

The study results are expected to address the following issues:

- (i) Establish the percentage deviations between targeted project construction duration and actual contract duration.
- (ii) Establish the percentage deviations between targeted project construction cost and final completion cost.
- (iii) Establish the relationship between the project variables; initial contract sum, duration, extended times, additional costs, final construction completion time and cost.
- (iv) Build final cost predictive models/charts upon the relationship in (iii).

The anticipated results are going to be disseminated widely through seminars, conferences, workshops, technical journals, internet etc.

4.1 Discussion of Related and Earlier Studies

Azis *et al.* (2013) investigated the contributors to cost overrun and proposed fifteen (15) mitigating measures classified into pro-active strategy, organizational and fluid. Idoro (2012) concludes that the level of use of project plans can be a strategy for reducing the high time and cost overruns recorded in design-build projects given room for stakeholders to increase the level of use of project plans in design-build projects. The study suggested that stakeholders should ensure that the required project plans are prepared when projects are procured through design-build system. Bamisile (2004) argued that it is the construction methodology that determines the programme of works, and hence the duration. The construction methodology dictates the details of project quality management plan, which is used to achieve the specified

quality standards from effective site management. Odeyinka *et al.* (2012) presents a different perspective for investigating the solutions to cost overrun. The study modeled the impacts of risks on the variability between contract sum and final account. The focus was on creating awareness on issues capable of raising the signed contract price in the construction stage. An artificial neural network (ANN) for predicting project final cost was recommended. Edwards (2009) in proffering solutions to the negative impacts of cost overrun in United States of America recommended a fundamental reform which is, to terminate and privatize as many federal activities as possible, and move funding for state activities, such as highways, back to the states. That way, federal policymakers could focus on ensuring that the few needed areas of federal spending, such as defense, are carried out as efficiently as possible". This seems a management and executive strategy for dealing with the issue of cost overrun. Gandu (2014) proposed a mathematical proactive cost management model for building projects in Nigeria. The model seems **not** to have considered all the variables that influence cost growth. While project durations seem to address material and labour price galloping others, like contractor's managerial powers, gratifications etc. are part of the variables upon which the mathematical model should have been built. Aiyetan *et al.* (2012) investigated the relationship between initial and final contract time with the aim of developing an equation for reasonably estimating project completion period and derived the following: $Y = 13.1159 + 1.1341X$, where Y is final construction time and X targeted contract duration set at tender stage. That study only focused on contract duration.

5 Conclusion

This paper addresses the conference sub-theme "Emerging trends in construction project delivery" and specifically, trends in international construction issue of cost variability. It is a preliminary part of an ongoing Ph.D. thesis in the department of Construction Economics & Management, Faculty of Engineering and Built Environment, University of Cape Town. Models/Charts derived from this study shall serve as solutions to the current trend of cost variability particularly in the Nigeria construction industry. The findings shall also serve as tools for future project planning to enhance smooth cash flow projections. Project abandonments, which major cause is sudden upsurge in fund requirements, leading to loss of investment interest, shall be reduced when the expected models/charts become operational.

6 Acknowledgement

My appreciations go to Prof. (Mrs.) Abimbola Windapo, and Mr. Sunday Odediran, who gave the conference invitation and guides, Dr. Augustine Okoronka, Mr. Omogbai Barracks and Mr. Amos Chom for the assistances given in directing and sharpening the paper focus. Most important are the experts in the cidb review committee that reshaped the ideas and put in standard formats at the abstract and full paper levels without which the paper could have fallen short of the quality required. Finally I am thanking the Almighty GOD for inspirations and supplies of good health and resources used in the study.

7 References

- Agboola, T., Egunjobi, L., Olatubara, C. O., Yusuf, D. O. and Alabi, M. (2013). *Contemporary social science research methods: A practical guide*. Lagos: Murlab Searchwisdom Educational Services.
- Aiyetan, A.O., Smallwood, J.J. and Shakantu, W. (2012). A linear regression modeling of the relationship between initial estimated and final achieved construction time in South Africa.
- Amusan, L. M, Joshua, O, Owolabi, J. D, Tunji-Olayemi, P. and Anosike, M. N. (2013a)

- Expert system-based exploratory approach to cost modeling of reinforced concrete office building. *International Journal of Engineering and Technology*, 3(1) 86-95.
- Amusan, L.M., Mosaku, T.O., Ayo, C.K. and Adeboye, A.B. (2013b). Expert system-based predictive cost model for building works: Neural network approach. *International Journal of Basic & Applied Sciences IJBAS-IJENS*. 13(01). 36-44
- Atkinson, R. (1999). Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. *International Journal of project Management*, 17(6), pp 337-342.
- Azis, A. S. B., Memon, A. H., Rahman, I. A. & Kazim, A. T. A (March 2013), Controlling cost overrun factors in construction project in Malaysia. *Research Journal of Applied Sciences, Engineering and Technology* 5(8):2621-2629.
- Baccarini, D. and Collins, A. (1999). The concept of project success-what 150 Australian project managers think.
- Bamisile, A. (2004). *Building production management*. Lagos: Foresight Press Limited.
- Duggal, J. S. (2015). Project management institute, Inc. www.pmi.org.
- Edwards, C. (2009). Government cost overruns. Retrieved from www.downsizinggovernment.org/government-cost-overruns.
- Gandu, Y. J. (2014) *Developing a proactive cost management model for building projects in Nigeria* (Ph.D. Research Seminar (Third Seminar) in Construction Management, Department of Building, Faculty of Environmental Design, Ahmadu Bello University, Zaria).
- Gonzalez, J. S. (June 2007). *Using fuzzy mathematical models for construction project scheduling with time, cost, and material restrictions*. (An M.sc Thesis Presented to the Faculty of the RUSS College of Engineering and Technology, Ohio University).
- Hammad, A. A. A, Ali, S. M. A, Sweis, G. J. and Bashir, A. (2008). Prediction model for construction cost and duration. *Jordan Journal of Civil Engineering*, 2(3). 250-266.
- Hasan, R., Suliman, S.M.A and Al-Malki, Y. (2014). An investigation into the delays in road projects in Bahrain. *International Journal of Research in Engineering and Science (IJRES)*. 2(2) pp. 38-47.
- Idogho, P.O. (2001). *Introductory research & statistics for business students*. Kaduna:Ida-Ken Publishers.
- Idoro, G. I. (2012). Influence of project plans on the outcome of construction projects procured by design-build (DB) in Nigeria. *Journal of Construction in Developing Countries*, 17(2). 81-103.
- Iredia, P. A. (2003). *Research project writing*. Ibadan: Dacom Publishers.
- Keeling, M. J. & Rohani, P. (2008). *Modeling infectious diseases in humans and animals*. New Jersey: Princeton University Press.
- Kirk, R.E. (2008). *Statistics an introduction*. 5th ed. Belmont: Thomson Wadsworth.
- Morenikeji, W. (2006). *Research & analytical methods*. Jos: Jos University Press.
- NIOB. (2002). *NIOB hand book*. Lagos: The Nigerian Institute of Building.
- Nnorom, C. O (1998). *Cost implications of variations in construction projects in Nigeria* (M.sc Thesis, Department of Building, Ahmadu Bello University, Zaria. Nigeria).
- Odediran, S. J. & Windapo, A. O. (2014). Systematic review of factors influencing cost performance of building projects. *In Proceedings of the 8th cidb Postgraduate Conference, Johannesburg, February*, pp 501-510.
- Odeyinka, H., Larkin, K., Weatherup, R., Cunningham, G., Mckane, M., & Bogle, G. (2012). *Modeling risks impacts on the variability between contract sum and final account*. A report for Royal Institution of Chartered Surveyors.
- Otunola, A. T. (2008). Construction cost and time overrun: A builders perception of contributory factors. *The Professional Builder*. n.v, (n.is.no), 18-23.

- Rahman, I. A., Memon, A. H., Azis, A. A. A. and Abdullah, N. H. (2013). Modeling causes of cost overrun in large construction projects with partial least square-SEM approach: Contractor's perspective. *Research Journal of Applied Sciences, Engineering and Technology*, 5(6), 1963-1972.
- Seeley, I. H. (1976). *Building economics*. 2nd Edition. London: The Macmillan press Ltd
- State House (2005). *The ABC of the contract (Due Process Policy): A manual on public procurement reform programme in Nigeria*. Abuja: Budget Monitoring and Price Intelligence Unit.
- Ugulu, R. A & Ikwoogu, A. (2011). Analytical process leading to final cost differential of construction project in Nigeria: Developers' perspective.
- Vidalis, S. M. & Najafi, F.T. (2002). *Cost and time overruns in highway construction*. Paper presented at the 4th Transportation Specialty Conference of the Canadian Society for Civil Engineering. Montréal, Québec, Canada.

THEORIZING SPECULATIVE LOW-INCOME HOUSING DEVELOPMENT IN DEVELOPING COUNTRIES

Taruvinga, Bridgit Gugulethu; Mooya, Manya Mainza

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, South Africa

Abstract

The housing of low-income groups is a global challenge that many developing countries' governments are grappling with. Most empirical studies aimed at addressing this challenge however appear to lack an explicit theoretical grounding, making their generalizability to different contexts to be problematic. This paper reviews the theoretical frameworks that can be applied in housing research and assesses how these theories may be applied in the study of speculative low-income housing development in the context of developing countries. Property development theories can be categorized into three broad categories: neo-classical, neo-Marxist and structuralist theories. Findings from a critique of each of these broad categories of theories show that structuralist theories are more appropriate in the study of speculative low-income housing development. The study concludes that appropriate policy recommendations that can be of use in stimulating private sector engagement in low income housing have to be tailor-made to suit different types of developers and have to be anchored on an understanding of developer strategies in response to risks posed by the target groups, the macroeconomic environment, and institutional constraints and enablers. The State, through policy, can stimulate more speculative developers to produce tailor-made products suited to the target group, which will contribute towards reducing the housing challenge.

Keywords: Developing countries, Low-income housing, Policy, Private sector, Theory

1 Introduction: Problem of Low Income Housing Development

The low-income target group is typically characterised by low, unstable and/or undocumented incomes, no credit history and lack of collateral (Lea, 2005; Loxley, 2013; Moss, 2001; Stein and Castillo, 2005). These characteristics imply that mortgage funding for housing is ordinarily not an option, and there is need for government assistance in housing the low-income target group. These characteristics coupled with housing being a basic need result in housing provision for this group ordinarily falling under the ambit of the state (Mosha, 2013; Moss, 2003; Özdemir, 2011; Wang, Shao, Murie, and Cheng, 2012).

However, in most developing countries, scholarly evidence points to public sector efforts in the provision of housing falling short compared to the overall demand for housing that is exerted on the market by the low income group (Moss, 2003; Özdemir, 2011; Sivam and Karuppanan, 2002). The major reason accounting for state failure in the provision of low-income housing in most developing countries is huge fiscal constraints and large budgets that are not sustainable (Babatunde, Opawole and Akinsiku, 2012; Lea, 2005; Loxley, 2013). Other reasons include but are not limited to: rapid population growth, increased urbanization, displacement of people by natural disasters and conflict and limited technical resources (Abdul-

Aziz and Kassim, 2011; Babatunde et al., 2012; Loxley, 2013). As a consequence of these state challenges, the housing backlog in most developing countries has been ballooning every year, prompting researchers to look for alternative solutions to the housing challenge for the low income group.

One way to ameliorate the state challenges is to tap into private sources of capital through engaging the private sector in the provision of low income housing. The private sector is also deemed to possess a better skill-set, which enables it to complete housing development projects ahead of schedule due to different work values, tenacity in resolving challenges and advanced project risk management structures, which is good for low-income housing delivery (Loxley, 2013). But, if private capital is to be mobilized for low-income housing development it is imperative that the investor considers sources of revenue inflow, an exit strategy for capital recovery and profitability to make the investment justifiable (Demirag, Khadaroo, Stapleton, and Stevenson, 2011; Rust, 2007; Stein and Castillo, 2005). This exit strategy is hampered by a number of challenges that are present mainly due to the characteristics of the target market and by the fact that low-income housing is a politically sensitive issue that the state and other players feel they can easily manipulate for their gain (Cowan and McDermont, 2008; Lea, 2005; Özdemir, 2011; Samaratunga and O'Hare, 2014). As a consequence of this political risk, most low-income housing projects suffer from policy unpredictability (Altmann, 2011) and are also inflexible in terms of housing design as state stakeholders sometimes unnecessarily insist on unreasonably high standards that are not backed by the payment capabilities of the low income sector (Abdul-Aziz and Kassim, 2011; Mosha, 2013; Moyo, 2014; Rakodi, 1990). Dependence on private capital for low-income housing development which is provided by risk averse shareholders would thus entail finding means and ways of pricing and packaging all the risks inherent in the low income housing sector in such a manner that the private sector can then determine if this group can be profitably served, whilst maintaining affordability by the target group (Demirag et al., 2011; Gallimore, Williams, and Woodward, 1997; Lea, 2005; Moss, 2003)

In developing countries, in addition to the above cocktail of challenges, the private sector would have to operate within an economically challenging atmosphere, which is not conducive for large scale projects (Centre for Affordable Housing Finance in Africa, 2012; Lea, 2005; Moss, 2003; Özdemir, 2011). At the same time, it is in those countries where there is the greatest housing backlogs and thus the greatest need to look for ways to engage the private sector. The challenge of how to incorporate the private sector in low income housing production has attracted many researchers in a bid to find solutions to the world wide challenge of housing the low income groups (Abdul-Aziz and Kassim, 2011; Babatunde et al., 2012; Loxley, 2013). Numerous empirical studies have been done on the topic, but their generalizability has been hampered by the problem that many of them have not been guided by explicit theoretical frameworks, a concern which has also been noted even amongst property development researchers in general (Drane, 2013). Without a theory to bind together all the empirical evidence that may be gathered on speculative low income housing, research in this area can end up being too descriptive, with limited ability to be applied in other contexts (Carmen, Steggell Susan, Binder Lori, Davidson Pat, and Vega Eric, 2001; Coase, 1998; Ganderton, 1994; Jacobs and Atkinson, 2008; Mbiba and Huchzermeyer, 2002).

Given this context, the purpose of this paper is to review the theoretical frameworks that have been applied in housing research and to assess how these theories may be applied to the understanding of speculative low-income housing development in developing country contexts. The rest of the paper is arranged in four sections as follows. The following section briefly identifies and critically reviews the main theories that have been applied in housing research in general. Based on this review, the third section considers the most appropriate

approach to the theorizing of housing research in the context of developing countries. The penultimate section draws out the policy implications arising from this approach. The paper ends with conclusions and suggestions for research.

2 Theory in Housing Research

Theories that have been applied in housing research can be categorized into three broad categories, viz. neoclassical theory, neo-Marxist theory and structuralist theory.

2.1 Neoclassical Theories

Neoclassical economics refers to a set of approaches to economics focusing on the determination of prices, outputs, and income distributions in markets through supply and demand. At the core of neo-classical economics is consumer or rational choice theory. Neoclassical consumer theory begins its analysis by considering individuals, who are rational, and have full information but are income constrained as consumers only i.e. as purchasers of consumer goods. Neoclassical consumer theory is therefore essentially a demand-side theory. Thus though individuals may also act as producers in the market, this function is ignored in consumer theory. Megbolugbe, Marks, and dan Schwartz (1991) make the rather ambitious argument that this is the only fully developed economic theory of the housing market for analyzing housing decisions. This theory posits that consumption decisions are the product of preferences for houses with certain attributes, given constraints on supply and the resources available to make purchases. In the case of housing tenure decisions, for example, this theory suggests that decisions about owning versus renting housing are determined by the combination of individual demands for attributes associated with either type of tenure, and constraints on an individual's ability to access the desired kind of tenure.

Applied to speculative development of low-income housing in developing countries, the neoclassic consumer theory of housing demand has significant shortcomings. Perhaps the most fundamental of these is that it has nothing to say about the supply side of the housing market. This is of course where the developers come in. It is therefore inappropriate for the theorizing the question of speculative development of low-income housing. More broadly, the neoclassical consumer theory of housing demand suffers from the same problems associated with neoclassical economic theory. Neoclassic economic theory is based on the idea that the market can always correct itself and is frictionless (Buitelaar, 2004; Van der Krabben and Lambooy, 1993). A form of agent rationality is assumed which allows for unproblematic negotiation given certain structuring parameters which is ideal for perfect supply (Healey and Barrett, 1990).

Demand for low income housing is undisputedly there as is evidenced by housing backlog figures, but empirical evidence which points to market failure in the provision of low income housing to the low income segment is abundant (Craig and Porter, 2006; Özdemir, 2011; Rolnik, 2013; Sivam and Karuppanan, 2002). There is thus need for research on supply side variables (Follain and Jimenez, 1985), an area that is typically ignored by the neoclassical approach, which highlights that the metaphor of the invisible hand that ensures harmony of individual actions in a zero-transaction-cost world does not hold in the low income housing sector (Furubotn and Richter, 2005; Van der Krabben and Lambooy, 1993). Simulations of developer decision making from a neoclassical perspective have also been criticized as being isolated from real life human manoeuvring and also do not explain why developers behave in certain ways (Coiacetto, 2001). Yet, understanding why developers make the decisions that they make is the key that is needed to comprehend low income housing production by speculative developers. Property developers also have to depend on imperfect information (Ganderton, 1994) in the low income housing segment, which rules out the application of any theoretical models that are derived from a neo-classical perspective. The existence of imperfect

information in the low income housing market thus points to incomplete contracts (Furubotn and Richter, 2005) which further implies higher transaction costs. The importance of minimizing transaction costs cannot be overemphasized in low-income housing (Arnott, 1987), as cost minimization might make the final product more suitable to the target group.

2.2 *Neo-Marxist Theories*

Marxism is, in simple terms, a theory that sees society in terms of a class struggle between capitalists and the 'working class'. This in practical terms is conceptualized as conflict between those who own the means of production, who are rich, and workers, who are poor. The relations have traditionally been seen as exploitative, with the capitalists accumulating wealth at the expense of the poor workers. Neo-Marxism for its part is a loose term that encompasses strands of Marxist philosophy which seeks to answer questions traditional or orthodox Marxism cannot. The neo-Marxist theory of housing conceptualizes developers and landlords as the exploitative capitalist class, whose interests is at variance with the occupiers of low-income housing. Indeed there are a number of researchers in the low income housing space who assert that involvement of the private sector in low income housing provision is likely to result in the marginalization of the poor and more landlessness (Bredenoord and Verkoren, 2010; Campbell, 2011; Craig and Porter, 2006; Mosha, 2013; Rolnik, 2013; Seisedos, 2009). These theories and researchers working from this theoretical perspective would thus advocate for social justice and call for more government involvement in ensuring equitable wealth redistribution.

It's quite obvious that a neo-Marxist theory of housing is unlikely to lead to fruitful results in research whose objective is to understand the conditions under which speculative low-income housing development may be successfully undertaken. Neo-Marxist theory essentially vilifies landlords and developers as they are assumed to impose and manipulate rents so as to ensure the most profitable arrangement of land uses (Mbiba and Huchzermeyer, 2002). This assumption is however problematic because it wouldn't make economic sense for private developers to actively want to serve this low income housing market to the exclusion of other higher income groups who can afford higher rents. Adopting this theoretical stance would thus entail giving up the fight before even attempting to understand the ideologies and strategies of those private sector players who serve this market against calls by other researchers for research which targets how the private sector can be mobilized and encouraged in serving the lower end of the market (Abdul-Aziz and Kassim, 2011; Altmann, 2011; Bredenoord and Verkoren, 2010; Lea, 2005; Miller, 2010).

Since the subject of study is the low income groups, those without the adequate means of outrightly affording housing on the open market, the neo-Marxist perspective would advocate for more subsidy as a form of wealth redistribution. But, governments in developing countries are already operating on bloated budgets and not much fiscal resources can be spared that can adequately help meet housing demand that is exerted by this group (Chipungu and Adebayo, 2013; Lea, 2005; Loxley, 2013). The social implications will be reluctance to adopt alternative housing solutions such as self-help schemes even by those groups in the society who have the means to get access to housing (Landman and Napier, 2010). Failure also by the government to provide housing under the neo- Marxist perspectives can lead to civil unrest within the society, especially if the low income groups take it as an infringement of their rights.

2.3 *Structuralist Theories*

Structuralist theories seek to relate and understand the behaviour and actions of individuals (or agents) as arising from, and shaped by, underlying structure. The balancing of agency (action) and structure is referred to as the duality of structure, and looks at how structure affects the actions of agents and how it is also affected by agency. Structural theories hence have the power to explain why low income housing provision by speculative developers is the way it is

today through applying theory to empirical evidence to get a sense of how structure affects and is affected by agents. The roots of structural concepts in housing are class, production, capital accumulation, power, and conflict (Lawson, 2009).

Class: Theories which utilize these structural concepts do recognize housing delivery systems differ depending on the targeted market (Gumbo, 2010). This implies that structural theories would not view housing as a homogenous product and would not expect demand patterns and supply patterns to be exactly the same for different classes. As such, the out-come would be different structures of housing provision (Ball, 1998). Similarly, developer expectations of profit margins, house design patterns, marketing efforts, risk management strategies should be differentiated per class, a notion which can be tested through using structural theories. Unlike the neoclassical approach which focuses on demand side economics, structural theories can enable both demand and supply side economics to be interrogated after stratifying the market into different classes.

Production and capital accumulation: Production of low income housing depends on the rate of capital formation i.e. increase in the volume of real savings, mobilization of savings through financial and credit institutions, and investment of savings (Lawson, 2009). This implies that low income housing production is affected by the macro economic environment (Leung, 2004) and producers have to act in this environment which can also be a constraint towards capital accumulation. Indeed, there are researchers who attest that it is impossible for the private sector to profitably go into low-income housing development and bring authentic social and economic development for the target market (Campbell, 2011; Craig and Porter, 2006; Rolnik, 2013; Seisedos, 2009). But, instead of taking a neo-Marxist perspective and assuming that speculative developers involved in low income housing can only make a profit through charging excessive prices, adopting a structural perspective can enable researchers to explore institutional concepts such as transaction cost minimization, methodological individualism, social capital and so on (Furubotn and Richter, 2005). These concepts can make it possible for speculative developers to leverage on their strategies and come up with profitable delivery systems that are suitable for the low income earners.

Power: In any housing market, different participants can be said to have different competences or powers. This difference can arise from unequal opportunities in access to resources, differing ideologies and for some, political affiliations can give an advantage over other market participants. Structure addresses resources available to developers, rules governing economic activities within the market and motivation or objectives of the market players (Healey and Barrett, 1990), and interrogating these concepts can yield insight into what can be done to stimulate low income housing production. In low income housing studies, this power becomes evident when some developers are able to successfully serve the low income earners whilst some can't. Adoption of structural theories in low income housing research will thus reveal some of these variables that can yield insight into what determines low income housing production success.

Conflict: the potential for conflict amongst market participants serves to highlight the importance of structure, that is, the rules that shape human interaction (Buitelaar, 2004) and promote cooperation among human agents so that the costs of coordinating economic and other activities can be lowered (Furubotn and Richter, 2005). In low income housing research, information asymmetry abounds (Arnott, 1987; Ball, 1998; Lawson, 2009), which emphasizes the concept of bounded rationality amongst market participant. Without structure to serve as a fall-back position in case contracts fail, in a bid to reduce risks, there would be a rise in transaction costs (Buitelaar, 2004).

3 Theorizing Speculative Low Income Housing Development

Having noted that structural theories are more appropriate in the study of low income housing by speculative developers, the two widely recognized property development theories stemming from the structural theory are Healy's Structure-Agency theory and Ball's Structures of Housing Provision (SoHP) model. Each model applies institutional concepts differently which will affect the suitability of each of the models in the study of low income housing. Institutional analysis is important for this research because institutions provide structure- that is limits or constraints to business and human practice which can influence how low-income housing development takes place (Callinicos, 2004). On the other hand, structures reduce uncertainty in human relations (Furubotn and Richter, 2005), and thus can contribute significantly towards reducing transaction cost in low income housing provision.

SoHP does not differentiate between structure and agency (Ball, 1998). Instead, the model concentrates on mapping out the structures of housing provision which are defined as the network of relationships of all players involved in housing provision. It thus concentrates on the ontology of housing provision, i.e. what are the networks, but ignores the epistemological side, which is what we need to understand in order to promote private sector involvement in low income housing. Structure-Agency on the other hand recognizes that different property developers are unique and provides a structured way to understand individual actors involved in the production process (Healey and Barrett, 1990). This might be time consuming compared to just lumping up all the low income housing developers under one stereotypical banner, but it is a necessary step that has to be taken in order to understand the speculative low income housing production process determinants.

Given that under institutional economics, individuals are assumed to maximize utility under constraints (Furubotn and Richter, 2005), the SoHP falls short in exploring this concept as it just provides a way of visually mapping how organizations are linked. Although the SoHP acknowledges that these networks are influenced and/or constrained by rules, it lacks the explanatory power to explain how agents then react to these constraints. Instead the researcher would have to deduce from a longitudinal study how the constraints have resulted in a change in networks, making the model less useful in cross sectional studies which are more frequently carried out. This in a way, assumes that all the reactions to constraints are translated into changes in networks, but, this is not always the case as cultural norms can make a structure of provision rigid such that it might not fully reflect the agents' reaction to certain institutional constraints. The Structure-Agency theory on the other, by separating between structure and agency, enables the researcher to fully explore how agents maximize utility under given constraints. This is of ultimate importance in the study of low income housing by the private sector as the sector is fraught with challenges as was shown above.

Bounded rationality (Eggertsson, 1990; Furubotn and Richter, 2005) is a concept that has to be fully explored in the provision of low income housing by the private sector. Information asymmetry abounds in this sector which exacerbates risks, and this implies that private developers have to make do with incomplete information and incomplete contracts (Buitelaar, 2004). The Structure-Agency theory enables the interrogation of the ideologies of the private sector players and the strategies that they employ to cope with the unique risks imposed by this information asymmetry. By separating structure and agency, it is possible to explore how agents are affected by structure and how their actions also influence structure which tests the duality of structure and agency and this model gives the researcher a chance to check influential variables which can then be used to explain a particular structure of provision. Ball's structures of housing provision on the other hand does not separate between structure and agency and the author states that there may be no contemporary rationale for the existence of a particular structure. Although this might be true, this perspective does not equip researchers with much

to go on in low income housing research that is targeted on finding ways of attracting private sector developers into the sector, which will result in researchers having to resort to other theories in order to answer some research questions that they may have.

4 Implications for Policy

Once frictions are noted in a market as is evident in the low income housing sector, economic behaviour will be assumed to include the development of enforcement rules and the necessary collective action to support the rules (Furubotn and Richter, 2005), which is where policy comes in. Therefore, appropriate policy recommendation that can be of use in stimulating private sector engagement cannot be gleaned from any studies that adopt a neoclassical theoretical perspective. If policy makers were to understand why developers behave in a certain way and how they are likely to react to certain policy changes, then they could actively start pursuing the implementation of policies that are likely to encourage more private players in the low income housing space. Policy should thus be crafted, not with a blanket view of the property development sector, but should be tailor made to suit different types of developers. If policy makers are made aware of the significance of structure in shaping developer outlooks, then more care and attention will be given in policy crafting to influence more involvement of the private sector. Researchers however agree that neoliberal policies are path dependent and contingent processes that materialize differently according to contextual realities (Altmann, 2011; Fawaz, 2009; Rolnik, 2013; Wang et al., 2012) and as such, empirical research on low income housing production should be used to inform policy.

This emphasizes the role of government policy in low income housing production. The state enters into these processes in diverse ways, through sectoral policies, as a development intermediary itself, and in order to safeguard particular interests and values (Healey and Barrett, 1990). However, the financial and economic interest of the private sector need to be harmonized with the political and social needs of the government and that can only happen through policy intervention. Through using the Structure-Agency theory, the effect of current government policy on the operations of practicing speculative low income housing producers will be uncovered. From the challenges faced and strategies that are being implemented, government, can, through policy, help the speculative developers produce a tailor made product suitable to the target group in all aspects. Issues that have been consistently raised by other researchers such as bureaucratic land acquisition and planning procedure, tenure, housing standards, costs of exchange and so on are likely to be exposed, but in greater detail which show the relative importance of policy reform on speculative low income housing production

5 Conclusion and Further Research

Low income housing shortages are real, the world over, more so in developing countries. The solution to the housing challenge will take a concerted effort from researchers, practitioners and policy makers. Policy, however, has to be adequately informed for it to have the desired effect. This can be achieved by research that draws on an appropriate theoretical framework and is also backed by empirical evidence that fits the context in question. The Structure-Agency theory that flows from structural theory is a promising theoretical entry point that can be used to research ongoing speculative low income housing development in a bid to unravel effects of current policies on speculative low income housing. Results from such researches are also going to highlight challenges being faced by the developers, giving the state a chance to use policy as a tool to reduce barriers to entry for the private sector developers, and to create a structural environment that is conducive to the creation of a product that is affordable to low income earners.

Although Healy's Structure-Agency theory appears to be more suitable in the study of low income housing provision by speculative producers, there is still a need to interrogate the model

and come up with a robust conceptual framework that will capture all the variables that can affect private sector involvement in the housing sector in developing countries.

6 References

- Abdul-Aziz, A.-R., and Kassim, P. J. (2011). Objectives, success and failure factors of housing public–private partnerships in Malaysia. *Habitat International*, 35(1), 150-157.
- Altmann, M. P. (2011). *Contextual development economics: A holistic approach to the understanding of economic activity in low-income countries* (Vol. 8): Springer Science and Business Media.
- Arnott, R. (1987). Economic theory and housing. *Handbook of regional and urban economics*, 2, 959-988.
- Babatunde, S. O., Opawole, A., and Akinsiku, O. E. (2012). Critical success factors in public-private partnership (PPP) on infrastructure delivery in Nigeria. *Journal of Facilities Management*, 10(3).
- Ball, M. (1998). Institutions in British property research: a review. *Urban studies*, 35(9), 1501-1517.
- Bredenoord, J., and Verkoren, O. (2010). Between self-help – and institutional housing: A bird's eye view of Mexico's housing production for low and (lower) middle-income groups. *Habitat International*, 34(3), 359-365.
- Buitelaar, E. (2004). A transaction-cost analysis of the land development process. *Urban studies*, 41(13), 2539-2553.
- Callinicos, A. (2004). *Making history: agency, structure, and change in social theory* (Vol. 3): Brill.
- Campbell, A. (2011). "Cuba: A Project to Build Socialism in a Neoliberal World". In P. Bond (Ed.), *Confronting Global Neoliberalism: Third World Resistance and Development Strategies* (pp. 101-116): SCB Distributors.
- Carmen, D., Steggell Susan, K., Binder Lori, A., Davidson Pat, R., and Vega Eric, D. (2001). Hutton and Amelia, Rodecap, R. The role of theory in the study of housing. *Housing and Society*, 28, 1and2.
- Centre for Affordable Housing Finance in Africa. (2012). Opportunities for Social Housing Investment in South-Africa: Report Prepared for Nedbank.
- Chipungu, L., and Adebayo, A. (2013). The policy-planning divide: an evaluation of housing production in the aftermath of operation Murambatsvina in Zimbabwe. *Journal of Housing and the Built Environment*, 28(2).
- Coase, R. (1998). The new institutional economics. *American Economic Review*, 72-74.
- Coiacetto, E. J. (2001). Diversity in real estate developer behaviour: A case for research. *Urban Policy and Research*, 19(1), 43-59.
- Cowan, D., and McDermont, M. (2008). Obscuring the public function: a social housing case study. *Current Legal Problems*, 61(1), 159-189.
- Craig, D., and Porter, D. (2006). *Development beyond neoliberalism?: Governance, poverty reduction and political economy*: Cambridge Univ Press.
- Demirag, I., Khadaroo, I., Stapleton, P., and Stevenson, C. (2011). Risks and the financing of PPP: Perspectives from the financiers. *The British Accounting Review*, 43(4), 294-310.
- Drane, J. (2013). *The State of Contemporary Property Development Theory*. Paper presented at the Pacific Rim Real Estate Society (PRRES) Conference.
- Eggertsson, T. (1990). *Economic behavior and institutions: Principles of Neoinstitutional Economics*: Cambridge University Press.
- Fawaz, M. (2009). Neoliberal Urbanity and the Right to the City: A View from Beirut's Periphery. *Development and Change*, 40(5), 827-852.

- Follain, J. R., and Jimenez, E. (1985). Estimating the demand for housing characteristics: a survey and critique. *Regional science and urban economics*, 15(1), 77-107.
- Furubotn, E. G., and Richter, R. (2005). *Institutions and economic theory: The contribution of the new institutional economics*: University of Michigan Press.
- Gallimore, P., Williams, W., and Woodward, D. (1997). Perceptions of risk in the private finance initiative. *Journal of Property Finance*, 8(2), 164-176.
- Ganderton, P. (1994). Modelling the land conversion process: a realist perspective. *Environment and Planning A*, 26(5), 803-819.
- Gumbo, T. (2010). Eccentric housing finance sources by the urban poor in Zimbabwe: case of Cowdray Park low-income self help housing scheme in Bulawayo. *Economia. Seria Management* 13 (1), 89-104.
- Healey, P., and Barrett, S. M. (1990). Structure and agency in land and property development processes: some ideas for research. *Urban studies*, 27(1), 89-103.
- Jacobs, K., and Atkinson, R. (2008). Special issue: theoretical concerns in Australian housing and urban research. *Housing, Theory and Society*, 25(3), 157-163.
- Landman, K., and Napier, M. (2010). Waiting for a house or building your own? Reconsidering state provision, aided and unaided self-help in South Africa. *Habitat International*, 34(3), 299-305.
- Lawson, J. (2009). *A review of structurally inspired approaches in housing studies: Concepts, contributions and future perspectives*. Paper presented at the International Conference Housing Assets, Housing People, 1-4 September 2009, Glasgow.
- Lea, M. (2005). *Attracting private capital into low-income markets*. Paper presented at the Housing Finance International: More than shelter: Housing as an instrument of economic and social development, Bellagio Study and Conference Center-Bellagio (Como), Italy.
- Leung, C. (2004). Macroeconomics and housing: a review of the literature. *Journal of Housing Economics*, 13(4), 249-267.
- Loxley, J. (2013). Are public-private partnerships (PPPs) the answer to Africa's infrastructure needs? *Review of African Political Economy*, 40(137), 485-495.
- Mbiba, B., and Huchzermeyer, M. (2002). Contentious development: peri-urban studies in sub-Saharan Africa. *Progress in Development Studies*, 2(2), 113-131.
- Megbolugbe, I., Marks, A., and dan Schwartz, M. (1991). The Economic Theory Of Housing Demand. *Journal Of Real Estate Research*, 6(3), 381-393.
- Miller, D. (Ed.) (2010). *How Neoliberalism Got Where It Is: Elite Planning, Corporate Lobbying and the Release of the Free Market*: Zed Books Ltd.
- Mosha, A. C. (2013). Low-Income Access to Urban Land and Housing in Botswana. *Urban Forum*, 24(1), 137-154.
- Moss, V. (2001). The state of housing finance in South Africa. *Housing Finance International*, 16(2), 30-35.
- Moss, V. (2003). Preview of housing finance systems in four different African Countries: South Africa, Nigeria, Ghana and Tanzania. *International Union for Housing Finance, London*.
- Moyo, W. (2014). Urban Housing Policy and its Implications on the Low-Income Earners of A Harare Municipality, Zimbabwe. *International Journal of Asian Social Science*, 4(3), 356-365.
- Özdemir, D. (2011). The role of the public sector in the provision of housing supply in Turkey, 1950-2009. *International journal of urban and regional research*, 35(6), 1099-1117.
- Rakodi, C. (1990). Housing production and housing policy in Harare, Zimbabwe. *Journal of Urban Affairs*, 12(2), 135-156.

- Rolnik, R. (2013). Late neoliberalism: the financialization of homeownership and housing rights. *International journal of urban and regional research*, 37(3), 1058-1066.
- Rust, K. (2007). The role of housing microfinance in supporting sustainable livelihoods. *Housing Finance International*, 22(2), 42-49.
- Samaratunga, T. C., and O'Hare, D. (2014). 'Sahaspura': the first high-rise housing project for low-income people in Colombo, Sri Lanka. *Australian Planner*, 51(3), 223-231.
- Seisdedos, P. C. (2009). Chapter 1 "Late Neoliberalism" in Brazil: Social and Economic Impacts of Trade and Financial Liberalization. In R. Westra (Ed.), *Confronting Global Neoliberalism; third world resistance and development strategies* (pp. 39-66): Clarity Press.
- Sivam, A., and Karuppannan, S. (2002). Role of state and market in housing delivery for low-income groups in India. *Journal of Housing and the Built Environment*, 17(1), 69-88.
- Stein, A., and Castillo, L. (2005). Innovative financing for low-income housing improvement: lessons from programmes in Central America, 17(1), 47-66.
- Van der Krabben, E., and Lambooy, J. G. (1993). A theoretical framework for the functioning of the Dutch property market. *Urban studies*, 30(8), 1381-1397.
- Wang, Y. P., Shao, L., Murie, A., and Cheng, J. (2012). The maturation of the neo-liberal housing market in urban China. *Housing Studies*, 27(3), 343-359.

AN INVESTIGATION INTO STUDIO-BASED PEDAGOGY FOR BUILT ENVIRONMENT GRADUATES: A NEW MODEL FOR A NEW CONTEXT

Bremer, Tascha; Els, Mart-Mari

Department of Quantity Surveying and Construction Management, Faculty of Natural and Agricultural Sciences, Univeristy of the Free State, Bloemfontein, Free State, South Africa

Abstract

The democratization of South Africa has necessitated a transformation of the education system, it requires basic curriculum concepts and teaching practices to be rediscovered and, rethought. The process of democratisation of South Africa looks easy and many institutions have addressed the issue with regard to alignment, in terms of the curriculum outer structure or exoskeleton which only refers to modules, credits, levels, and outcomes. It is the classroom practices that remain unchanged in many respects. The purpose of this paper is to investigate the studio pedagogy as a possible new method in the education of Built Environment graduates, to meet the concepts as set out for South African higher education. A mixed method of research was followed, firstly qualitative by means of a literature study and secondly quantitative by means of two structured questionnaires. The findings indicate which current educational methods are used and where these methods are lacking. Studio-based pedagogy is a promising educational method to help students acquire the skills and knowledge to be more effective practioners as set out for South African higher education. This paper presents an investigation into the application of this method as a way to address the gap between education and practice, and help improve the current traditional methods of academic instruction.

Keywords: Studio-based pedagogy, Construction education, Curriculum development, Higher education, South Africa

1 Introduction

The South African education policy has contributed to a new context of learning. This has been influenced by many factors, especially globalization of the economy since 1994. Ramdass (2012) identifies skills development as a national concern, South African higher education institutions need to meet the expectations and be responsive to many role players including industry, state and society. These changes have led to the requirement of flexibility, adaptability and innovation not only in curriculum alignment, but importantly to new education and training demands in order to remain competitive (Ramdass, 2012). In essence, education institutions are called to be firstly attentive and secondly responsive to the need of the knowledge economy. Graduates need to become well-developed problem-solving individuals who can adjust their body of knowledge and skills to changing environments. The empirical study tests the perception of the students regarding the current curriculum and identifies gaps within current teaching and learning practices. Relating to the above teachers need to understand teaching methods, how students learn and industry requirements in order to bridge the gap as outlined by the study. The paper proposes the theoretical perspective of the proposed

pedagogy of problem based learning in a studio context that Biggs (1999) refers to as ‘alignment itself!’ as a possible solution. For the purpose of this paper, curriculum does not only refer to content but also to the teaching and learning of the programme of study: outcomes, methods, and assessment form integral parts of the curriculum (McDonald and Van der Horst, 2007).

2 Literature Review

2.1 *New Context: Economic and Policy Responsiveness*

The National Plan on Higher Education in South Africa provides the framework, and mechanisms for restructuring the system to achieve the vision and goals for higher education system outlined in the White Paper, A Programme for the Transformation of Higher Education (Department of Education 1997). The goals are summarised as three core concepts namely: curriculum alignment, globalization or internationalization, and quality assurance.

...high-level skills training: the training and provision of person power to strengthen this country’s enterprises, services and infrastructure. This requires the development of professionals and knowledge workers with globally equivalent skills, but who are socially responsible and conscious of their role in contributing to the national development effort and social transformation...Production, acquisition and application of new knowledge: national growth and competitiveness is dependent on continuous technological improvement and innovation, driven by well-organised, vibrant research and development system which integrates the research and training capacity of higher education with the needs of industry and of social reconstruction (White Paper, 1997).

In terms of the exoskeleton defined by Jansen in Lange (2011) as the outer structure: modules, credits, levels, and outcomes the process of democratisation of South Africa looks easy as far as the curriculum is concerned. It is the endoskeleton that remains unchanged in many respects. What has been neglected is Section 2 of the National Plan is the production of graduates for both social and economic development within South Africa. The objective can be outlined as ‘to produce graduates with the skills, and competencies to meet the human resources needs of the country’ (Ministry of Education, 2001).

What does ‘globalizing’ the curriculum mean? According to McDonald and Van der Horst (2007) it is a curriculum that is different in three ways namely: content (i.e. what is taught), form (i.e. delivery methods), and structure (i.e. the organization of the learning experiences and content of programmes). Teaching always involves firstly teaching something (content and skills) to someone somewhere (context). According to Jansen in Lange (2011) curriculum should be viewed as an institution, which reiterates the concept that knowledge is not only transmitted through syllabus content, but also in a tangible manner through classroom practices. It can be argued that too many policymakers and educational leaders are focused on traditional assessment approaches rather than answering the question of whether our students are learning what they need to know. If we are to align teaching to higher-level outcomes it is important to start asking the following questions of how it is carried out as well as how understanding develops within the curriculum. The need for globally competitive skills require these students to have firstly well-developed problem-solving skills and to be able to adjust their body of knowledge and skills to changing environments. Higher education focus should shift to providing students with broad, generic and transferable skills in contrast to the current context of specialised knowledge. Furthermore according to Griesel (2002) attributes considered to be most important by employers can be summarised as follows:

- Critical and analytical ability;

- Flexibility and ability to apply knowledge to new situations; and
- Ability to plan and execute tasks independently.

A University education is not just transmission of knowledge to perform a given profession, but should also include attributes such as rational debate and conceptual thinking. Schon rejects the ‘established procedure in professional education of building application upon basic science and theory; he dismissed the notion that professional practice was based on the rigorous application of theoretical knowledge’ (Green and Bonollo, 2003). This paper will argue that the studio-based pedagogy can provide construction professionals with an education in a real life context (Nompunga, 2013).

2.2 Studio-based Pedagogy: History

Educational theory offers five broad models as indicated by Long (2012) namely (1) behaviourist, (2) humanist, (3) cognitivist, (4) activist, and (5) situated learning. Understanding these is essential in assessing the value and potential of studio pedagogy for Quantity Surveyors and Construction Managers. As seen in the data collected our program approaches educating Quantity Surveyors and Construction Managers predominantly from a lecture point of view (behaviourist). Not to mention assessment, also approached by traditional practices of essays and problem-type examinations. The pedagogy of this model can be seen as ‘learning that exists in a traditional didactic format, where the lecturer is seen as the expert in disseminating knowledge’ (Long, 2012), also translating in the lecturer controlling the environment and offering rewards for students predetermined responses. According to the literature reviewed studio pedagogy can be placed in the ‘situated learning theory’ model because learning is centred on a problem or activity and the context becomes key, where learning is different for each student based on their abilities, knowledge and competency (Long, 2012).

It is important to examine the history behind the studio, since this will lead to an understanding of the educational approach that ultimately shapes its delivery and provides a guideline for its implementation. The model discussed in this paper can be seen as based on Plato’s model of teaching, the free exchange of knowledge later known as Platonism. Academia Platonism is a humanistic discourse; a free, sociable and informal means of discussion (Green and Bonollo, 2003). The architecture studio is an adaptation of this and the atelier-based training at the Ecole des Beaux-Arts in 19th Century Paris (Kuhn, 2001), it offers a teaching model which blends the social and technical aspects associated with design and provides interesting possibilities for other technical fields of education.

Architectural education is based primarily around the design studio as a pivot and gathering point of all knowledge and skill accreted throughout the curriculum (Mostafa and Mostafa, 2010).

The ‘studio’ is used to describe two concepts, firstly the physical space (the place where learning and teaching takes place) and secondly the mode of engagement (pedagogical strategy). It is based on the historic model as explained of apprenticeship, where the master educates the student (Crowther, 2013). Crowther (2013) refers to the ‘studio’ as a place of learning where the two concepts of physical space and pedagogical activities merge to form one. Ochsner (2000) states that there is potential for the pedagogy of the design studio to have wider application in other disciplines and professions. Architects have been educated through a process that revolves around the ‘studio course’ and this paper explores to apply the studio method of teaching to the education of other allied construction professions such as Quantity Surveying and Project Management.

2.3 New Model: Pedagogical Responsiveness

In a study conducted by Nompunga (2013), third year level Construction Management students at the Cape Peninsula University of Technology were asked to complete an online survey. The data revealed that a professional discipline requires theory to be applied to practice in the classroom setup. Students preferred direct face-to-face teaching which centres around the student rather than a conventional teacher-centred approach which typically focusses on what teachers teach rather than what students learn. Nompunga (2013) confirms this by stating that students do not want to learn basic concepts first and then apply them later on, but rather prefer to be involved in immediate, direct and first hand experiences. Research has also shown that students feel unprepared for their jobs because the integrating of theory learnt at institutions into their professional practice leaves a gap. A study conducted by Dlamini and Fester (2012) argues that students currently being trained are not acceptable for the construction industry which already is challenged by a skills shortage.

Lange (2011) refers to the development of a student into a critical being, persons that can exercise critical reason, critical self-reflection and critical action. In order to educate a critical being we need to provide a space for education where students can become themselves and bring their knowledge to situations (Lange, 2011). Nompunga (2013) encourages a deep approach to learning, this can be summarised as the following: Firstly the teacher should guide the learning process within his or her field of knowledge and secondly select the correct approaches that communicates this knowledge. This can further be summarised as teaching being the process of sharing knowledge to create better understanding (Nompunga, 2013). Assessment plays an important role to simulate the real world of construction. Assessment should encourage students to engage in problems that use and apply knowledge facilitating as discussed above in terms of deep learning approaches.

Chan (2012) advocates the use and growing teaching approach of construction undergraduates as Outcomes Based Teaching and Learning (OBTL). Academics can no longer teach in ways that were appropriate in the past, a paradigm shift has placed the focus on the learner and how to facilitate the best learning outcomes for them (Nompunga, 2013). Teachers should continually learn and adapt their practice to be seen as Dewey (1993) refers to them as ‘teachers as learners’, ‘teachers as researchers’ and ‘teachers as practitioners’. Design studios typically employ the semi-structured learning strategy of experimental learning; particularly, the project (Crowther, 2013) which as discussed above includes aspects of problem-based learning. This form of learning centres on dialogue, beginning with students given a project while tutors/mentors offer feedback weekly. What is the unique value of studio pedagogy in the education of Quantity Surveyors and Project Managers? Firstly its value lies in teaching ‘synthesis,’ ‘learning-by-doing,’ and ‘reflection-in-action’ while also incorporating or exposing the students to ‘real-world problems’ (Long, 2012), further he identifies the following as key learning objectives and contributors to learning of studio courses.

- Teamwork
- Professional socialization
- In-depth problem
- Adapting procedures to real cases
- Field experience

Furthermore, the complex and flexible nature of the architecture studio can be seen to accommodate three types of learning as indicated by Crowther (2013):

- Learning about design (knowledge development);

- Learning to design (development and application of skills); and,
- Learning to become (where learning transforms a student).

3 Research Methodology

A mixed method was used, firstly a literature review was done prior to data collection in terms of structured questionnaires. Two structured questionnaires was sent out to groups of students at the University of the Free State. The questionnaire was developed and constructed based on the literature review. It was aimed at assessing the student’s opinion of their learning experience, in terms of preparedness for work, current teaching practices and lecturers. For the purpose of the research conclusions will be made from the data collection in order to establish the gaps in the teaching practices as well as provide possible solutions for implementation.

3.1 Questionnaire construction

Both questionnaires were structured the same, the first part consisting of personal questions and the second of employment details. The third part of the questionnaires required the students to answer questions relating to their education. They had to rate the importance of education practices on a five point Likert scale, graded from one which is least- and five which is most appropriate. There were also open-ended questions where they were required to give their own opinion and respond with views or comments. Table 1 below shows the two sample populations, the response rate was 100%.

Table 1. Sample population 1 and 2

	Sample 1		Sample 2		
Under Graduate	55	88.7%	Under Graduate	10	19.2%
Degree	7	11.3%	Degree	34	65.4%
Honours	0	0%	Honours	7	13.5%
Other	0	0%	Other	1	1.9%
Total	62	100%	Total	52	100%

4 Findings and Discussion

4.1 Important attributes to be prepared for a long term career

When asked to what extent the students practise self-study, the results revealed only 3.8% of students regarded it as important. Vorster (2011) states that the goal of education ought to be to create independent, autonomous learners who take responsibility for their own learning. Improvements as seen in the literature can be achieved by moving toward learner-centred teaching (Vorster, 2011). Firstly the attitudes as well as abilities for this need to be cultivated in our classrooms. Lecturers need to shift the focus more on our students and how we can encourage them to become more independent learners, and this paper aims to show that the possible solution lies in studio-based pedagogy through the literature review and further research of implementation. Students will not be developed if lecturers still, as the data shows take responsibility for their learning. When asked to evaluate the important attributes for a long term career, Table 2 shows the mean score on a scale of 1 to 5, where 1 is the least important and 5 is the most important, 51.6% of the students rated analysis of problems as well as 45.2% creativity as most important.

Table 2. Important attributes to be prepared for a long term career

	1	2	3	4	5
Analysis of problems	0	0	9.7	38.7	51.6
Creativity	0	6.5	25.8	24.2	43.5
Application of knowledge	0	1.6	4.8	48.4	45.2
Evaluation of ability	0	0	25.8	40.3	33.9

4.2 Importance of elements in professional development

When asked to rate the importance of certain elements in terms of professional development, communication (50%) and people skills (46.1%) were rated as most important as indicated in Table 3 below. Toor (2008) supports this when he states that industry requires academia to produce professionals with not only technical but also soft skills as indicated by the data. Toor (2008) states that ‘technical coursework should be complemented with elements of flexible education, and emphasis on soft-skills development.’ The data shows a lack in the education of these soft skills in our current programme. Chan (2012) states that assessment efforts should also be made to involve ‘soft skills’, students should not only be evaluated on content-based knowledge but also on transferable skills which include as shown communication, problem solving, interpersonal relationships and teamwork.

Table 3. Importance of elements in professional development

	1	2	3	4	5
Communication	0	0	11.5	38.4	50
People Skills	0	0	15.3	38.4	46.1
Leadership	0	0	30.7	36.5	32.6
Motivation	0	1.9	21.1	51.9	25
Ethics	0	0	5.7	55.7	38.4
Creativity	0	7.69	30.7	48	13.4
Research methods	0	3.8	21.1	67.3	7.6

4.3 The impact of educational elements in terms of knowledge gained

The techniques used by construction education programs can have an important factor contributing to the type and quality of graduates and the success of these graduates in industry. When asked to indicate the impact of each of the following educational techniques in terms of knowledge gained while enrolled as indicated in Table 4, practical classes (9.6%), site visits (11.5%), group work (1.9%), research projects (0%) and computerised classes (5.7%) were rated as having the least impact. Students were then asked to name which of these elements were inadequately addressed and results reiterate the findings above listing practical classes, computerised classes and site visits. Study material was also found to be 0% but not listed as an inadequacy in the follow up question. The data indicates that the curriculum exoskeleton was not rated as an inadequacy but most of the educational elements that were lacking refers to the endoskeleton as indicated in the literature review. This proves predominant use of traditional assessment practices that cannot adequately test for creativity, reflection and critical thinking as stated by McDonald and Van der Horst (2007). Practices namely practical classes, site visits, group work etc. can have an impact on the qualities mentioned above but are not being implemented as indicated by the data. As indicated above the students have limited learning activities that encourages them to be able to think critically, reflect on problems and apply knowledge or concepts to new problems.

Table 4. The impact of educational elements in terms of knowledge gained

	1	2	3	4	5
Practical classes	9.6	11.5	34.6	28.8	15.3
Site Visits	11.5	11.5	21.15	34.6	21.1
Computerised assignments and classes	5.7	9.61	30.7	42.3	11.5
Group Work	1.9	34.6	46.1	15.3	1.9
Research projects	0	7.6	34.6	53.8	3.8
Attending seminars and Conferences	11.5	9.6	30.7	40.3	5.7
Study material	0	13.4	38.4	36.5	11.5

4.4 Studio-based pedagogy solutions addressing gaps in current educating practices of Built Environment graduates

The studio-based pedagogy addresses these issues above as seen in Table 5 below, in the following ways. Generally studios and students who participate in them, possess a set of common characteristics as summarised by Jones et al (1994):

Engaged learners are responsible for their own learning. These students are self-regulated and able to define their own learning goals and evaluate their own achievement. They are also energized by their learning; their joy of learning leads to a lifelong passion for solving problems, understanding, and taking the next step in their thinking. These learners are strategic in that they know how to learn and are able to transfer knowledge to solve problems creatively. Engaged learning also involves being collaborative – that is, valuing and having the skills to work with others.

Studios traditionally begin with an open-ended problem that gives students some choice in the direction but leaves a certain area for creativity. The problem takes account current issues and deals with ‘real world and client’ scenarios. The studio is a place where the project is executed and it should reflect professional practice (Green and Bonollo, 2008), he continues to state that this should not be isolated but rather complementary to other modules. This can and should include structured conversations with outside experts with knowledge of the problem, which comes back to the importance of industry development. Assessment usually takes place in the form of a critique, derived from architecture and fine art teaching. This is central to the studio and can also be termed review, assessment or evaluation. The studio also encourages a high degree of contact between the instructor and the student which again contribute to the development of soft skills such as communication and people skills. According to Long (2012) the students work is regarded as iterative, where the problem and the solution of the problem is revisited repeatedly. Knowledge is socially constructed and thus group work is crucial to developing a student’s knowledge base and people skills. Studios always include a degree of group assignments, as well as attempts to work across disciplines and promote collaboration. Studio courses teaches ‘practice’ for which there is no substitute pedagogy (Long, 2012). The next stage of the evolution, as stated by Long (2012) include questions such as how to engage technology and social media in new ways to teach within the studio setting. Studios as indicated by Long (2012) should be places where,

...creativity can be taught, where theory can be tested, where research can be conducted, where outreach and service activities can be deployed, and where different modes of practice can be explored.

Table 5. Studio-based pedagogy solutions addressing gaps in current educating practices of Built Environment graduates

Identified gap	Studio-based pedagogy solutions
Self-study	Student-centered learning
Analysis of problems	Critical reflection
Creativity	Open-ended problem Iterative work pattern
Communication	Critique – Formal and Informal Contact between instructor and student
People skills	Social environment Professional socialization Present work to peers and instructor for review and discussion
Group work	Multi-disciplinary and collaborative team assignments
Practical classes	Learning by doing
Site visits	Industry involvement- engaging experts
Research projects	Precedent Case studies
Computerised classes	Further research into applicable uses of technology (E-learning)

5 Conclusion and Further Research

It is time that academics not only address the curriculum as content but also in terms of how we teach to address what the students need to learn. The data suggest that a conventional teaching approach is still followed which typically only focus on what teachers teach and not how students learn, thus the teaching and learning environment need to change. There is definite potential as seen in the literature review for the pedagogy of the design studio to have a wider application on unrelated or related disciplines. Long (2012) states that: “Experience-based learning – including studios and internships – Is the most appropriate approach of teaching practice.” As shown teaching should be student-centred rather than teacher-centred to minimise and overcome the gaps in construction graduates education. This research should now be implemented in the department as a pilot or case study and aid the development of a studio-based module to assist current modules offered.

6 References

- Biggs, J.B. (1999). *Teaching for Quality Learning at University: What the Student Does*. Buckingham, UK: Society for Research into Higher Education/ Open University Press.
- Chan, K (2012). Performance assessment of construction undergraduates under curriculum reform. In: *International Construction Education Conference*, Durban, pp. 1-14.
- Crowther, P (2013). Understanding the signature pedagogy of the design studio and the opportunities for its technological enhancement. *Journal of Learning Design*, 6 (3), pp. 18-28.
- Department of Education (DoE) (1997). *Education White Paper 3: a programme for the transformation of higher education* (Pretoria, Government Gazette No. 18207).
- Department of Education (DoE) (2001). *National plan for higher education* (Pretoria, Department of Education).
- Green, L.N. and Bonollo, E (2003). Studio-based teaching: history and advantages in the teaching of design. *World Transactions on Engineering and Technology Education*, 2 (2), pp. 269-272.
- Kuhn, S (2001). Learning from the Architecture Studio: Implications for Project-Based

- Pedagogy. *International Journal of Engineering Education*, 17 (4, 5), pp. 349-352.
- Lange, L (2011). Conversations about quality in teaching and learning: Reflecting on the curriculum: Where do we stand? Prestige Forum for Teaching and Learning, Keynote, 3 November.
- Long, J.D. (2012). State of the Studio: Revisiting the Potential of Studio Pedagogy in U.S.-Based Planning Programs. *Journal of Planning Education and Research*, 32 (4), pp. 431-448.
- McDonald, R and Van der Horst, H (2007). Curriculum alignment, globalization, and quality assurance in South African higher education. *Journal of Curriculum Studies*, 39 (1), pp. 1-9.
- Nompunga, S (2013). Comparison of Different Approaches in the Teaching, Learning and Assessment of Construction Engineering Courses in South African Higher Education Sector. In: *2nd NMMU Construction Management Conference*, Port Elizabeth, pp. 101-109.
- Ramdass, K (2012). Programme Re-curriculation: An Experience at the University of Johannesburg. *International Journal of Business and Social Science*, 3 (8), pp. 204-210.
- Vorster, M.C. (2011). Teaching and Learning: The Critical Balance in Effective Education. *Journal of Construction Engineering and Management*, pp. 916-922.
- Toor, S.R. and Ofori, G. (2008). Developing Construction professionals of the 21st Century: Renewed Vision for Leadership. *Journal of Professional issues in Engineering Education and Practice*, 134 (3), pp. 279-286.
- Griesel, H. (2002). Universities and the world of work: A case study on graduate attributes. In Council on Higher Education, *Relations between Higher Education and the Labour Market*. Available online at http://www.che.ac.za/documents/d000037/Colloquium_Report.pdf
- Jones, B, Valdez, G, Nowakowski, J and Rasmussen, C. (1994). *Designing learning and Technology for Educational Reform*. Oak Brook, IL: North Central Regional Educational Laboratory.

CHALLENGES IN THE DELIVERY OF ENVIRONMENTAL SUSTAINABILITY IN HOUSING DEVELOPMENT IN ABUJA, NIGERIA

Ishaya, David Ayock

Department of Estate Management, College of Environmental Studies, Hussaini Adamu Federal Polytechnic, Kazaure, Jigawa State

Dabo, Daniel I.

Department of Quantity Surveying, College of Environmental Studies, Kaduna Polytechnic, Kaduna, Nigeria

Fadason, Ruya T.

Department of Quantity Surveying, School of Environmental Studies, Nuhu Bamalli Polytechnic, Zaria, Kaduna State

Abstract

The environment has a major impact on our lives; construction can affect communities and business and can make heavy demands on limited natural resources, however, when planned successfully it can also lead to positive outcomes. Sustainable development is the achievement of a better quality of life through the efficient use of resources, which realize continued social progress while maintaining stable economic growth and caring for the environment. The aim of this paper is to explore the challenges in the delivery of environmentally sustainable housing schemes in Abuja. The research uses desk study, which involves the review of related literature, and Delphi method, which is used in developing variables for the interview and survey questions. Abuja was selected, because of the level of housing development that is taking place there providing the ideal environment to undertake the study. Preliminary results show that there are challenges in achieving environmental sustainability in housing delivery in Abuja.

Keywords: Challenges, Delivery, Environmental sustainability, Housing development

1 Introduction

Housing provision is a major challenge facing not only developing countries but also the developed ones, for example, in the UK there exists a housing demand of over three million houses in England (Long et al., 1990). This challenge is more pronounced in developing Countries and will remain a major socio-economic and financial problem for these economies (Akintola et al., 2013). This problem led 131 Nations, including Nigeria, to endorse 64 recommendations of the ‘National Action Plan’ at the United Nations conference on Human settlement, on the 11th of June 1976 in Vancouver Canada. Meeting this challenge globally has led to plundering the natural environment without regards to its preservation or protection, and thus extends to a more complex problem. About 170 Nations met at Rio de Janeiro, Brazil, on June 3rd 1992 for another United Nation Conference tagged “Earth Summit,” or “Rio Declaration on Environment and Development.” The debate centred on sustainability, with particular emphasis on resolving the conflict between development and the environment,

however current debate is critical about the lack of post-Rio momentum at both political and practical level (Lozano, 2008).

Nigeria is a signatory to the 'Rio declaration' and is laden with a huge housing deficit. It struggles towards achieving sustainable environment are noticeable through the various policy formulations and advocacy (Odebiyi, 2010). The 1999 constitution, the pinnacle of all laws in Nigeria, has a provision for the protection of the environment, for example section 20 of the law states that: 'The State shall protect and improve the environment and safeguard the water, air, land, forest and wildlife of Nigeria' (FGN 1994). One of the local environmental laws, which have been enacted is: the Land Use Decree of 1978. There is also the National Policy on Environment (1989) concerned with securing the quality of the environment, conserving and using the environment for the benefit of present and future generations; restoring, maintaining and enhancing the ecosystem and ecological processes essential for the functioning of the biosphere and the principle of optimum sustainable yield in the use of natural resources. Another major provision of this policy is promoting public awareness on the link between development and the environment; international co-operation with countries and international organizations in the protection of the environment.

The aim of this paper is to explore the challenges in the delivery of environmental sustainable housing schemes in Abuja with particular emphasis on ways to address these challenges

2 Housing and Environmental Sustainability

As momentum continues to increase on concerns over the depletion of our natural environment, principle of sustainable practice has continued to raise more attention globally. The number of various concerned advocacy, conferences and seminars being held on the issue, evidences this. The activities within the built environment is said to contribute between 30-40 percent of greenhouse gases globally. (Abolore, 2012). As identified in literature, housing provision takes centre stage in depletion and pollution of the environment. Fiorino (1990) opines that the built environment provides a synthesis of environmental economic and social issues he asserts that it provides us with houses, infrastructures and also plays a vital role in our economy. Agbola (1998) concludes that its design is significant in determining the pattern for the resource consumption over its relative life cycle. Initiations have prompted philosophies and strategies in pursuing affirmative actions and policies in numerous countries to engage and implement sustainability issues in property valuation. Architects are also required to provide sustainable construction (Lorenz, 2006; Majdalam et al., 2006)

Arayela (2002) concludes that the transition to sustainability is urgent because global life-support systems and the environment have a time limit. Arayela posits that there is no time to dream of creating more living spaces or more environments, the remnants of the environment must be saved, time must be allowed for regeneration of what humans have already damaged.

Environmental sustainability is a globally – espoused objective, mainly credited to Brundtland commission (WCED, 1987), UNCED earth submit in 1992 and the position of Canada (1992). Environmental sustainability means maintaining global life support systems, or more specifically, maintaining environmental sound capacities to assimilate wastes and maintaining environmental sound capacities to regenerate raw materials, such as healthy air, water and so forth (Arayela, 2002). Therefore environmental sustainability means maintaining both the sources of raw materials and energy within its regenerative and assimilative capacities.

3 Conceptual Framework

Housing policies that focus on quantity, instead of quality, and that ignore the most basic sustainability guidelines, as well as the fact that many developing countries lack housing policy to speak of are issues that need to be addressed. While where such policies exist,

implementation become an outcry. Criteria is synonymous to indicators of environmental sustainability. Odebiyi (2010) stated that it is not clear what the phrases mean for analytical practice. The implication of that statement is that, there are varied criteria or indicators, which suggest the term to be genuine. Odebiyi (2010) studied the environmental equity and sustainability from the art benefit side, and concluded that Environmental Equity and sustainability are of major interest to those outside economics. The European Association for Bio-industries (2008) sets out Environmental sustainability creative for biofuels, the document finds that Environmental and Social criteria are equally important. The building and construction authority (2008) code for Environment sustainability of buildings version 1.0 allocate points for each of the category of the building criteria, which includes: energy efficiency, water efficiency, environmental protection, indoor environmental quality, other Green features. Addae et al. (2009) did a stakeholder analysis and local identification of indicators of the success and sustainability of farming based livelihood systems, which sets out sustainability indicators for natural resources management and policy. The document meet further to develop a set of indicator of the sustainability of farming based livelihood systems that can be used to assess or monitor the impact of policy and intellectual change, which will produce two set of indicators, external set of sustainability and the second set comprising local indicators of success. The studies identified internal indicators for sustainability in Uganda under the following themes Natural Physical, Financial, Human and Social.

Alabi (2012) analyzed Environmental Equity and sustainability rejecting the Kaldor-Hicks Criteria finding by Katie and Carol (2006) and Dietz and Neumayer (2007) and advocates a multi-criteria decision analysis (MCDA) framework, that the construction industry can use in ensuring that decision about built assets are balanced, feasible, desirable and as sustainable as possible. Studies by Metal et al. (2008) employed a numerical approach to measure performance, in terms of the following parameters, energy, land, water, materials, greenhouse gases, ozone, site ecology, solid waste, liquid effluents, noise, and quality aesthetics, durability, indoor environmental quality, adaptability, traffic, socio-economic and creative.

Studies by Dietz and Neumeyer (2007) agree that major difficulties with the assessment of sustainability, and the plethora of conceptualization and terminology has led to an equally diverse range of techniques and methods used to assess or appraise sustainability development. Lozano (2008) observes that Sustainability is a difficult concept for people to understand. Studies by Alabi (2012) found that there is a need to refine the decision making process for assessing sustainability applicable to the built environment the author also stresses that this should involve integrating various aspects of sustainability rather than dealing with discrete element of the problem.

Herath and Prato (2006) made use of various methods for assessment of environmental sustainability, which included multi-criteria analysis. Guy and Kibert (1998) discuss the local development of sustainability indicators, the authors concluded that sustainability indicators are principally about raising awareness and making environmental, economic and social sub-systems transparent to citizens and decision makers: whilst Bond and Saunders (2011) brought up a range of assessment issues, including the difference between “green” and “Sustainable” references and benchmarks, target performance levels, potential version actual performance version actual performance qualitative and quantitative criteria. Bond and Saunders (2011) identified three dimensions of assessment criteria (human, site, ecological); Time (past, present, future) and scale (materials, components, site, community, regional, global) and stated that the notion of a universally applicable tool that would be widely adopted in different countries was questionable. Lenz (2006) found that the existing design and assessment tools used do not address the many economic, social and performance facets over the life span of a building; and do not provide building assessment results for all dimensions of sustainable

development. Lenz highlighted that the maturity of sustainability evaluation begins with the assessment of the technical building design and construction costs, followed by the introduction of life cycle costs (LCC) and life cycle assessment (LCA) to the further introduction of social aspects and utility, resulting in an Integrated model that evaluates technical building design in the context of economic, social and environmental criteria.

4 Environmental Sustainability in Nigeria

With an area of 923,770sqkm, Nigeria is the largest country in tropical West Africa. It extends between latitude 4° 16' N and 13° 52' N and between longitude 2° 49' E and 14° 37' E and bounded by Cameroun and Chad Republic to the East, Niger Republic to the North and Benin Republic of to the West. The southern coastline is dominated by the Delta of the River Niger. Although Nigeria is the twelfth largest country in Africa, it contains a quarter of the continents people and a greater population than any other country in Africa. The country has a great diversity of ecosystems that range from the rainforest through dry savannah to dry lands and flat coastal zones to plateaus and highlands. The current environmental issues in Nigeria like most developing countries cover soil degradation, rapid deforestation, urban air and water pollution, desertification, oil pollution - water, air and soil have suffered serious damage from oil spills: loss of arable land and rapid urbanization (Alabi 2012). Erosion is one of the identified ecological problem that have affected many cities. Solid waste characteristics in Nigeria are similar to those of other developing countries and can be classified into residential, municipal and industrial waste (Iyagba, 2012). In many cities, waste is disposed of informally at open dumps.

5 Challenges to Environmental Sustainability

Past studies on sustainability has been focused on areas as wide as tourism (Kruja and Hasaj, 2010). Studies by Lenz (2006) look at barriers that affect the implementation of environmental management initiatives in an organization. The study further notes that the implementation of an environmental management strategy involves several dynamic stages that may be affected by various barriers. The barriers that may affect an organization depend on: its size; incompatibility with corporate culture; lack of information and knowledge; lack of resources; formal and informal management styles; presence of multiple stakeholders with conflicting interest; and the stage of development of the organization of environmental programmers.

Most of these barriers may be related to one another and often the presence of one barrier may increase the likelihood of or lead to, the presence of another barrier. The following strategies that can be utilized to overcome potential barrier and improve implementation of environmental programmers' strategies identified by Djokoto and Dadzie (2013) are: identifying the driving factors that affect an organization; education; training and communication; aligning the organizations environmental management strategies; identifying and sharing resources.

6 Methodology

The research uses desk study, which involves the review of related literature, and Delphi method, which is used in developing variables for the interview and survey questions. A semi-structured interview protocol was used in eliciting information on the challenges of environmental sustainability. The first round of interview involved nine professionals who were selected on a set of criteria (see Fellows and Liu, 2008). The second round of interviews involved three key professionals who were selected based on their knowledge in the field of environmental sustainability and housing to validate or disprove the themes generated by the first round of interviews (Garson, 2007). The first set of answers provided was compared to the extant literature, in other to develop the key variable using the open-ended technique. For

detail on the Delphi and survey methods see (Fellows and Liu, 2008; Fink, 2003). The rationale for adapting this approach hinges on a number of cogent considerations as outlined by Gill and Johnson (2012). Hakim (1997) observed that the method offers a logical template to study selected issues exhaustively, they further assert that approaching research work without being constrained by predetermined categories of analysis contribute to the depth, openness and details of qualitative enquiry. The researcher will be able to have a first-hand experience or in depth knowledge of challenges of housing development on environmental sustainability. Abuja was selected, because of the level of housing development taking place, which will provide the ideal environment to undertake the study. The research used data obtained from interviews for analysis. The questions were first developed using Delphi method to carry out a first round of interviews of nine respondents, who were experts in their field. They included Architects, builders, town planners, estate surveyors, environmental managers and quantity surveyors; however contractors and the end users were not included in the Delphi techniques which culminated in the development of the interview questions.

7 Findings and Discussions

7.1 Challenges of delivering environmental sustainability in housing schemes in Abuja

For the challenges in the delivery of sustainability in housing development the key informants all agree that stakeholders' perception of environmental sustainability and the challenges to the delivery of environmental sustainability is directly correlated and that the relationship is also significant. Some of the challenges to the delivery of sustainability in housing development are the mentality of people who believe that concrete is better than green lawns, the cutting of trees to be used for construction (as wood) and the cutting of the trees to make way for construction work which is in line with earlier findings by Abolore (2012), Agbola (1998), and Watuka and Fiorino (1990). Also a challenge to environmental sustainability is that construction managers and construction supervisors don't know environmental sustainability very well, this may be as result of low level of awareness or lack of awareness as observed by Lenz (2006), and Djokoto and Dadzie (2013). Another notable factor is in the design not being inclusive and integrating nature, the emphasis is on artificial buildings, which agrees with findings by Herath and Prato (2006), Peloza et al. (2012) and Long et al. (1990). Also of note is the finding that there is no articulate policy and legislation that spells out the indices and process to achieving environmental sustainability, which conforms to findings by Lozano (2008), Megbhenu, (2003) and Freeman (1984); non-inclusion of the community in the policy framework to enhance the environment, which agrees with findings by Fiorino (1990), Long et al. (1990), and John et al. (2012). Akintola et al. (2013) notes that there is an implementation gap in adaptive strategy for environmental sustainability as a result of barriers within the residential community.

8 Conclusion and Further Research

The findings from the extant literature and semi-structured interview indicates that land uses, design of houses, affordability and availability of materials for housing, community involvement in activities that would influence or affect the environment and the process in which environmental sustainability would be carried out, policy framework are key factors that need to be considered in overcoming the challenges in environmental sustainability in the Nigerian Federal Capital Territory of Abuja. The non-inclusion of communities and other stakeholders may affect the results obtained, as it is not a true reflection of the generality of the stakeholders. Further research can be carried out to include the exempted stakeholders. A large number of stakeholders may be used, which would allow the use of factor analysis to factor in

the variables as it affects embedding environmental sustainability into the housing delivery process in Abuja.

9 Limitation

The purpose of this research was mainly focused on Architects, Town Planners, Estate Surveyors, Quantity Surveyors, Builders, and Environmental Managers, which is not a true reflection of the totality of the stakeholders in environmental sustainability in the Nigerian Federal Capital Territory of Abuja. Hence the findings cannot be generalized to the totality of the stakeholders group. The number of the Delphi interviews and subsequent personal interviews were limited due to obvious reasons as outlined by the criteria for Delphi techniques.

10 Acknowledgement

The authors wish to thank Mr. James Hartwell and Professor David Bryd of The Liverpool John Moore's University, UK who supervised the MSc Thesis, from which this paper was extracted.

11 References

- Alabi, A. A. (2012). Comparative Study of Environmental Sustainability in Building Construction in Nigeria and Malaysia. *Journal of Emerging Trends in Economics and Management Sciences*, 3(6), 951-961.
- Addae D., Liu K. H. and Neu, Y. S. (2009). Sustainability of Sustainable Real Property Development. *Journal of Sustainable Real Estate*, Vol. XVIII, No. 1.
- Agbola.G. (1998) Using an Integrated Performance Approach in Building Assessment Tools. *Building Research and Information*, 34(4), 334-56.
- Akintola, S., Ogunbiyi, M., Adesokan, A. and Ayodeji, A. (2013). The Missing links Between Construction Sector and Development in Nigeria; A Polycentric Planning Perspectives.
- Arayela. A. (2002) Towards a Comprehensive rural housing policy in Nigeria. *Rural Environment and Sustainable Development in Nigeria*. Ado-Ekiti Nigeria: Research Group for African Environment and Development, University of Ado-Ekiti,
- Bond, A. J. and Morrison S. A. (2011). Re-evaluating Sustainability Assessment, Aligning and Vision and the Practice. Environmental Impact Assessment Review.
- Dietz, S. and Neumeyer, E. (2007). Weak and Strong Sustainability in the SEEA; Concepts and Measurements.
- Djokoto, S. D. and Dadzie, J. (2013). Barriers to Sustainable Construction in the Ghanaian Construction Industry - Consultants Perspectives. In Proceedings of the West African Built Environment (WABER) Conference, Accra Ghana.
- Fellows and Liu (2008) Research Methods for Construction 2nd edition, UK, Blackwell Science
- Fink, A. (2003). The Survey Handbook 2nd edition, California Sage Publication.
- Fiorino. D. J (1990). Citizen Participation and Environmental Risk: A Survey of Institutional Mechanisms. *Science, Technology and Human Values*, 15(2), 226-243.
- Freeman R. E. (1984). Strategic Management: A Stakeholder Approach. Boston Pitman.
- Garson G. D. (2007). Survey Research <http://www2.chass.ncsu.edu/garson/PA765/surveyhtm> accesses on 15 July 2013
- Gill, R. and Johnson, P. (2012). Research Methods for Managers 3rd Ed. Sage Publications.
- Guy, G. B. and Kibert, C. J. (1998). Developing indicators of sustainability: US experience. *Building Research & Information*, 26(1), 39-45.
- Hakim, C. (1987). Research Designs Strategies and Choices in the Design of Social Research,

- USA and Canada, Routledge
- Herath, G. and Prato, T. (2006) Using Multi-Criteria Decision analysis in National Resource Management, Ashgate, Aldershot.
- Iyagba, A. (2012). A Comparative analysis of Construction Industry in Nigeria and Malaysia.” *Journal of Contemporary Issues in Real Estate*, 1(1), 84-95.
- Peloza, J., Moritz L., James C., and Michael M. (2012), “Sustainability: How Stakeholder Perceptions Differ From Corporate Reality,” *California Management Review*, 74-97s
- Lenz, M. (2006). What is Stopping Sustainable Building in England: Barriers Experienced by Stakeholders in Delivering Sustainable Development, Oxford Institute of Sustainable Development, School of Built Environment Oxford Brookes University, UK.
- Katie.W and Carol, D. (2006) What is Stopping Building in England;Barriers,Experienced by Stakeholders in Developing Sustainable Development.Oxford Institute of Sustainable Development,School of Built Environment,Oxford Brookes University.UK
- Kruja, D. and Hasaj, K. (2010). Comparisons of Stakeholders Perception Towards the Sustainable Tourism Development and its Impacts in Stikodra Region (Albania). *TURIZAM*, 14 (1), 1-12.
- Long, P., Perdue, R. and Alen, L. (1990). Rural Residents Perceptions and Attitudes by Community Level of Tourism. *Journal of Travel Research*, 28(3), 3-9.
- Lozano. R. (2008). Envisioning Sustainability Three Dimensionally. *Journal of Cleaner Production*, 16, 1838-46.
- Megbhenu. J. and Ahadzie, J. (2013). Perception of the Financial Sector Towards Real Estate Investment in Sub-Saharan Africa-case study of Ghana. In Proceedings of the West African Built Environment (WABER) Conference, Accra Ghana.
- Odebiyi, S. (2010). Sustainable Housing Development in Africa; Nigerian Perspectives. *International Business and Management*, 1(1).
- Trinkhaus, H. L and Hanne, T. (2005) Know cube for MCDM: Visual and Interactive Support for Multi-criteria Decision Making. *Computers and Operations Research*, 32(5), 1289-309.

EVALUATING THE BUDGETARY RELIABILITY OF DESIGN STAGE ELEMENTAL COST PLAN IN BUILDING PROCUREMENT: A NEW ZEALAND STUDY

Adafin, Johnson Kayode

*Department of Civil & Environmental Engineering, Faculty of Engineering, The University of
Auckland, Auckland 1142, New Zealand*

Wilkinson, Suzanne Jane

*Department of Civil & Environmental Engineering, Faculty of Engineering, The University of
Auckland, Auckland 1142, New Zealand*

Rotimi, James Olabode Bamidele

*Department of Built Environment Engineering, School of Engineering, Auckland University of
Technology, Auckland 1010, New Zealand*

Odeyinka, Henry Agboola

*Department of Quantity Surveying, Faculty of Environmental Design & Management, Obafemi
Awolowo University, Ile-Ife, Nigeria*

Abstract

Accurate prediction of final tender sums (contract sums) of building projects depends on reliable projections of baseline cost plans developed at the design development stage. However, no matter how much care and effort is put into the preparation of design stage elemental cost plans, deviations are usually observed between these cost plans and the final tender sum. This makes accurate predictions challenging for construction practitioners in New Zealand. The major attributable factors for the observed variability are inherent risks in the design stage elemental cost plan development. Whilst this is recognised, this study evaluates the reliability of elemental cost plans in traditional building procurement. The study seeks to answer the question: is elemental cost plan a reliable budgetary tool for construction projects? The study was undertaken based on 20 completed building projects from which secondary data were collected within the New Zealand construction industry. Data analysis was carried out using document analysis and percentage deviation of final tender sums from the cost plans. Further analyses were carried out using root mean square and relative mean absolute deviation methods of analyses. The results showed that the budgetary reliability of elemental cost plans varied depending on project types. Whilst a deviation of -3.67% and +3.95% was obtained on the residential projects analysed, the deviation on educational projects was between -3.98% and +12.15%. Commercial projects attracted -14.22% and +16.33% while in the case of refurbishment projects, a deviation of -10.07% and +30.14% was obtained. These findings suggest that the larger or more complex a project is, the less reliable it is to use elemental cost plans to guarantee cost certainty.

Keywords: Elemental cost plan, Final tender sum, New Zealand, Reliability, Traditional building procurement

1 Introduction

The main concerns of construction clients in New Zealand are projects delivered within budget, on time, to the expected quality and with no surprises (Alan et al., 2008). Potts (2008) suggested that most clients work within tight pre-defined budgets or cost plans prepared by the consultant Quantity Surveyor at the design development stage. This is normally not expected to be exceeded; otherwise the whole scheme may fail. According to Odeyinka (2010) risks in traditional procurement are covered through the allocation of contingencies to cover both foreseen and unforeseen circumstances in design stage elemental cost plans. This is expected to ensure the completion of a project within the budget or cost plan. However, there are evidences in construction management literature indicating that it is difficult to find a project in which the final tender sum is the same as the design cost estimate/cost plan estimate (Akintoye, 2000; Aibinu and Pasco, 2008; Odusami and Onukwube, 2008; Enshassi et al., 2013).

Further, related studies conducted by researchers in the UK, Middle East, Asia and Africa concluded that in procurement methods where cost plans are used, deviations between the cost plan sums and final tender sums are common. Such deviations in the region of +1% to +12% are mentioned in (Morrison, 1984; Cheong, 1991; Oladokun et al., 2011; Enshassi et al., 2013). According to Zou et al. (2007) the major attributable factors for these deviations are risk elements that are inherent in construction project developments.

Whilst these risk factors are recognised, the study determines the reliability of design stage elemental cost plan in building project procurement. This study provides information on cost plan and final tender sums of selected case study projects in New Zealand. This represents a benchmark for measuring cost planning accuracy or reliability. Although the usefulness of design stage elemental cost plan and final tender sum as pre- and post-contract cost control tools in traditional procurement has been documented, to the best of the knowledge of the researchers, there is no recent documentary evidence of an investigation into the budgetary reliability of design stage elemental cost plan in traditional building procurement in New Zealand construction. As such, the study finds its significance.

2 Literature Review

2.1 An Overview of Elemental Cost Planning

Early study by Dent (1978) defined cost planning as a system for monitoring cost at building design stage such that: (a) tenders do not exceed preliminary estimates; and (b) costs are developed in a way that gives project owners the best value for money. According to Seeley (1996) cost planning is a systematic application of cost criteria to a building design process to maintain in the first place, a sensible and economic relation between project parameters (cost, time, quality and functionality) and in the second place, provide overall control of proposed expenditure as circumstances might dictate. Several contemporary authors including (Ashworth, 2004; Ashworth and Hogg, 2007; Kirkham, 2007; Smith and Jaggar, 2007; Ashworth, 2008) have expressed that cost planning is not only a pre-tender estimating method but also seeks to offer a control mechanism during the design stage.

Building cost planning was originally developed within the framework of the traditional procurement arrangement using conventional documentation, tendering and administration processes. With the advent of alternative forms of procurement and with more fluid approaches to design stage processes and documentation, the need for sound cost planning has not diminished (Smith et al., 2004). Thus, as a process established on solid theoretical foundations, Smith et al. suggested that cost planning should be robust enough to adapt and flourish in a variety of procurement environments.

In view of the above expressions and within the context of the current study, cost planning is simply a term that describes any system of bringing cost advice to bear upon a design process. In the same vein, design stage elemental cost plan is a pre-contract or specifically, a design stage cost control strategy based on elemental cost analysis which is prepared during the design development to give construction clients value for money. This bears in mind the need to meet specific requirements and ensure that available funds for a project are rationally distributed among the elements of the building. In this context, measuring the reliability of an elemental cost plan (a budget) means assessing the quality of the cost plan in term of the expected accuracy range. Consequently, the reliability of a cost plan is determined by whether the expected accuracy range matches the required accuracy range. Meanwhile, the accuracy of a cost plan can be defined as the difference between final tender sum (contract sum) and elemental cost plan sum; this can be measured by the error rate calculated from Equation (1) (An et al., 2011):

$$[1] \text{ Error rate (\%)} = (| \text{Final Tender Sum} - \text{Elemental Cost Plan Sum} | / \text{Final Tender Sum}) \times 100.$$

Similar view was illustrated in (Ashworth, 2004) whereby a range of -4% to +15% was recommended as an acceptable parameter for measuring estimating accuracy.

2.2 Previous Studies

Substantive research has been carried out in the field of pre-tender estimating for construction projects, a significant outcome of which is the identification of numerous risks that influence budgetary performance. Also some studies have investigated the accuracy of design stage elemental cost plans and their respective measure of influences, which is similar to the focus of the current study. Several researches (Akintoye, 2000; Enshassi et al., 2005; Aibinu and Pasco, 2008; Odusami and Onukwube, 2008; Onukwube et al., 2009; Oladokun et al., 2011; Jafarzadeh, 2012) have indicated that pre-tender estimating accuracies are significantly affected by the level of risk information available to estimators. These are recognised by this study as fundamental evidence of risk factors causing variability between elemental cost plans and final tender sums (Choy and Sidwell, 1991; Ling and Boo, 2001; Baloi and Price, 2003; Hlaing et al., 2008; Tsai and Yang, 2010).

The disparity between design stage elemental cost plan and final tender sums received in competition for a project would provide further evidence to the issues relating to the accuracy of pre-tender cost estimates in this study. Morrison (1984) had investigated this disparity in the United Kingdom by collecting and analysing data from seven separate quantity surveying firms. Morrison found that a mean deviation of 12% was obtained by the quantity surveyors. Also Ogunlana (1991) reported significant deviations of design cost estimates from accepted tenders using information held by seven design offices in the United Kingdom.

Cheong (1991) found that the disparity between cost plan estimates and contract sums is generally between 5% and 10%. Cheong's study had collected opinions across a wide range of Quantity Surveyors in Singapore. Significantly, Cheong's analysis of 88 projects from one quantity surveying consultancy in Singapore found that variability values between cost plan estimates and contract sums ranged from 33.79% (over-estimates) to 31.30% (under-estimates).

Similarly in Nigeria, Odeyinka and Yusif (2003) using cost data on preliminary cost estimates and lowest tenders that were supplied by 24 quantity surveying firms, found the following: 17 of 40 building projects (42.5%) had their lowest tender sums lower than the Quantity Surveyors' estimates and this ranged between 1% and 47%. 23 of the projects (57.5%) had their lowest tender sums higher than the Quantity Surveyors' estimates and this ranged between 1% and 174%. An analysis of pre-tender cost estimating performance of a Nigerian consulting

quantity surveying firm by Oladokun et al. (2011) found that on 81 building projects there was an estimate bias reflecting underestimates of about 34%.

In a related study, Odeyinka (2010) asserted that no matter how much care and effort is put into the preparation of design stage elemental cost plans, deviations observed between them and the final tender sums are usually significant. According to Zou et al. (2007) the major reason for this is inherent risks in both design and construction. The traditional way of dealing with these risks is merely to allow a percentage as contingency allowance. Thus, the essence of having an elemental cost plan as a budgetary tool for building projects is defeated if these risk elements are not captured or properly evaluated. Overall project objectives regarding cost, time and quality targets become threatened.

2.3 Risk and Cost Predictability

Risk could have different meanings to different people (Baloi and Price, 2003). The concept of risk can vary according to individual's perceptions, attitudes and experiences. For instance; architects, engineers and contractors are more likely to view risk from a technological perspective while lenders and developers tend to view it from an economic and / or financial point of view. Baloi and Price therefore concluded that risk is generally seen as an abstract concept that is difficult to measure. Rezakhani (2012) defined risk as a potential for complications around project completion, achievement of project objectives and an uncertain future event or condition whereby the occurrence rate is greater than 0% but lesser than 100%. Risk generates an effect on at least one of the main project objectives in terms of cost, time and quality targets. Early study by Akintoye and MacLeod (1997) explained that risk has been significant owing to the occurrence of budget/cost and schedule/time overruns associated with construction project developments. Joshua and Jagboro (2007) submitted that risk is inevitable and exposes project activities to adverse consequences of future events. The effect of risk on a project can be positive or negative. To align with the common usage of the word risk, this research embraces the view that benefits or positive impacts of risks on project objectives could be achieved by minimising risk occurrence and its detrimental impacts.

Potts (2008) explained that the budgeted cost established by the consultant Quantity Surveyor at the pre-contract stage forms the basis for the assessment of the tender sums submitted by bidding contractors. The successful tender therefore becomes the final tender sum (contract sum) for the project. Potts suggested that most clients work within tight pre-defined budgets/cost plans which are usually part of a larger overall scheme. If a budget or cost plan is exceeded, the whole scheme may fail. Pre-contract estimating produces the original budget or cost plan and this forecasts the likely expenditure for the client. The budget or cost plan should be used positively to make sure that the design stays within the scope of the original scheme. Thus, many budget overruns are due to circumstances observed as risk factors and an important issue is the ability to predict such factors and the impact they have on the project. The smaller the level of information available at the early stages of a construction project, the higher is the level of uncertainties and hence risks. This view was shared by Zou et al. (2007) and Taroun et al. (2011). Therefore, as project information increases, risk is expected to decrease.

There has been lesser attention paid to the disparity between design stage elemental cost plan and final tender sums in New Zealand. Recently, Adafin et al. (2014) undertook a preliminary exploration of the theoretical concepts and methods for assessing risk impacts on the variability between design stage elemental cost plan and tender sums in New Zealand. It is apparent that there is a dearth of literature on this subject, which is being addressed by this study.

3 Research Methodology

This study was carried out primarily through the use of secondary data. The research approach collated data on elemental cost plan and final tender sums from twenty completed building

projects located in Auckland (AKL), Christchurch (ChC) and Wellington (WLT), New Zealand. Access was obtained to project records held by three quantity surveying firms based in Auckland. Project records and documents produced by professionals and organizations were explored as the main data analysis for the study (Gibson and Brown, 2009). A thorough examination of their project files within the limitations of the Privacy Act was undertaken. Apart from this project information, five senior partners within the three firms who had worked closely with the projects were interviewed. Project data were collected from four different types of building projects.

Tables 1-5 present the project information obtained for residential, educational, commercial, and maintenance projects. These project details were analysed to achieve the research objective, which was to evaluate the budgetary reliability of design stage elemental cost plans in each of the four project types. For the purpose of anonymity, the projects are coded P01 - P20. In this study, the use of document analysis helped to justify the theoretical conclusions generated from the review, regarding cost predictability. Simple descriptive analysis was used to express the percentage difference between cost plan and final tender sums (Nworgu, 2006). Two further analyses were carried out using root mean square (RMS) deviation, and relative mean absolute (Rel. MAD) deviation methods of analyses as adopted by (Odeyinka et al., 2009). The *RMS* is expressed mathematically as follows:

$$[2] \text{RMS} = \sqrt{\left\{ \frac{1}{n} \sum_{i=1}^n (c_i - o_i)^2 \right\}}$$

Where *RMS* is the root mean square deviation measure; *n* is the number of projects investigated, *c_i* is the cost plan sum for individual project and *o_i* is the final tender sum for the individual project.

The *Rel. MAD* is expressed mathematically as follows:

$$[3] \text{Rel. MAD} = \frac{1}{n} \sum_{i=1}^n \frac{|(c_i - o_i)|}{c_i}$$

Where *Rel. MAD* is the relative mean absolute deviation measure; *n* is the number of projects investigated, *c_i* is the cost plan sum for the individual project and *o_i* is the final tender sum for the individual project.

4 Findings and Discussion

Demographic information obtained from participants included their designation, academic and professional qualifications and work experience. Generally, all of the respondents hold tertiary education at HNC/HND/Bachelor's degree levels in quantity surveying, while one of them holds an MBA. They are senior partners in their individual firms and are professionally qualified (three full members and two fellows) with the New Zealand Institute of Quantity Surveyors (NZIQS). The participants have an average of 28 years of work experience in their consultancies. This demographic information indicates that the participants have been involved with running of projects and therefore have some knowledge of issues relating to project cost planning. This also enhances validity of survey data. Therefore, the secondary data provided by them could be relied upon for this study.

Table 1 presents elemental cost plan sums and final tender sums for five residential building projects studied. An analysis of the percentage difference between the cost plan sum and final tender sum gives an indication of the budgetary reliability of the elemental cost plan. It is evident from the Table that the percentage difference between the cost plan and final tender sums ranges between -3.67% and +3.95%. This falls within the ±5% range adopted by

Morrison (1984) as the acceptable accuracy range between the Quantity Surveyor's estimate and the accepted or final tender sum. Similarly, a range of -4% to +15% was recommended by Ashworth (2004) as an acceptable standard for measuring estimating accuracy.

Table 1. Budgetary reliability measures for residential building projects

Project Code	Elemental	Final Tender Sum (NZ\$)	Cost Difference (NZ\$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
	Cost Plan Sum (NZ\$)						
P01	7,210,250.80	6,859,266.32	-260,984.48	-3.67	2013	AKL	Traditional
P02	794,456.98	815,257.68	20,800.70	2.62	'12-13	ChC	Traditional
P03	905,500.00	924,680.00	19,180.00	2.12	'12-13	ChC	Traditional
P04	1,914,848.40	1,878,417.15	-36,431.25	-1.90	2013	AKL	Traditional
P05	1,034,360.00	1,075,210.00	40,850.00	3.95	'12-13	ChC	Traditional

Though, traditional contracting systems in New Zealand require contractors to prepare their own quantities in a lump sum competitive contract. The schedules of quantities prepared by contractors are usually in a trade format while cost plans are produced in an elemental format by the consultant Quantity Surveyors during design development stage. Hence, this does not allow a compatible platform for comparison. It is noteworthy that the budget or cost plan established by the consultant Quantity Surveyor during the design development stage forms the basis for the assessment of tender sums submitted by bidding contractors. The successful tender therefore becomes the final tender sum (contract sum) for the project. A thorough examination of the cost plan and final tender summary for each of the five projects studied showed a minimal difference between the cost plan sums and final tender sums. This then suggests that in traditional procurement where elemental cost plan based on New Zealand Institute of Quantity Surveyors (NZIQS) Elemental Analysis of Costs of Building Projects is used, the cost plan tends to be a reliable budgetary tool. This is not unsurprising because residential building projects are usually well defined in terms of design and specification at their pre-construction phases. This view was shared by Ling and Boo (2001) explaining that the risk of variation and change in scope is usually very low during the construction phase for this category of projects.

Table 2 presents the cost plan data and final tender sums for five educational building projects. An analysis of the percentage difference between the cost plan and final tender sums gives an indication of the budgetary reliability of the cost plan. Data on the Table show that the percentage difference between the cost plan and final tender sums range between -3.98% and +12.15%. This range is significant. The high disparity observed, may suggest that the cost plan is not a very reliable budgetary tool in educational building projects. As evident from the cost plan and final tender summary, high variability was observed in some cases which suggested the occurrences of risk factors such as client's change, incomplete design information and site investigation information among others. This finding justifies Potts' (2008) suggestion that failure to keep within the provisions of pre-defined budgets or cost plan is one risk that impacts on a project's budgetary performance and consequently the client's cash flow position.

Table 2. Budgetary reliability measures for educational building projects

Project Code	Elemental Cost Plan Sum (NZ\$)	Final Tender Sum (NZ\$)	Cost Difference (NZ\$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
P06	994,678.00	1,084,000.00	89,322.00	8.98	2013	AKL	Traditional
P07	2,403,619.00	2,477,000.00	73,381.00	3.05	2013	AKL	Traditional
P08	944,000.00	906,409.00	-37,591.00	-3.98	2013	AKL	Traditional
P09	34,922,850.0	38,628,000.0	3,705,150.0	10.61	2012	ChC	Traditional
	0	0	0				
P10	48,833,750.0	54,768,250.6	5,934,500.6	12.15	2012	ChC	Traditional
	0	5	5				

Table 3 presents the cost plan data and final tender figures for five simple and complex commercial building projects. An analysis of the percentage difference between the cost plan and final tender sums shows a range between -14.22% and +16.33%. This is a very significant deviation. Further scrutiny of the percentage difference for each of the five projects indicates that the larger the scope of the commercial building, the higher the level of disparity between the cost plan sum and final tender sum. A thorough examination of the cost plan and final tender summary for each of the five projects showed a high disparity between the cost plan sums and final tender sums. The observed high variability therefore suggests that the elemental cost plan is not so much a reliable budgetary tool for commercial projects, especially where the project is large in scope and of a complex nature. This further suggests that there is uncertainty in a lot of project information available where large and complex projects are involved. Hence, it is noteworthy that the more uncertain the project information is at the pre-construction stage when elemental cost plan is prepared, the more risky it is for cost certainty to be guaranteed to the client at the end of the tendering process.

Table 3. Budgetary reliability measures for commercial building projects

Project Code	Elemental Cost Plan Sum (NZ\$)	Final Tender Sum (NZ\$)	Cost Difference (NZ\$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
P11	1,985,000.00	2,085,369.83	100,369.83	5.06	'12-13	AKL	Traditional
P12	31,000,000.00	26,593,185.00	-4,406,815.00	-14.22	2012	ChC	Traditional
P13	33,225,000.00	38,650,125.00	5,425,125.00	16.33	'11-12	ChC	Traditional
P14	2,850,000.00	3,058,252.85	208,252.85	7.31	'12-13	AKL	Traditional
P15	28,245,000.00	31,285,225.00	3,040,225.00	10.76	2010	AKL	Traditional

Table 4 presents the cost plan data and final tender figures for five refurbishment projects. An analysis of the percentage difference between the cost plan and final tender sums shows a range between -10.07% and +30.14%. This presents a highly significant deviation. It is important to note that the highest positive variability emanated from a small maintenance project and the Table does not reflect a clear-cut pattern of percentage variability. A thorough examination of the cost plan and final tender summary for each of the five projects showed a high disparity between the cost plan sums and final tender sums. The observed significant variability suggests that the elemental cost plan is less reliable as a budgetary tool in refurbishment projects. This is not a surprise as refurbishment projects harbour loaded estimates and assumptions that cater for higher risks due to unknown items involved in terms of scope and complexity at project inception, hence unpredictability regarding cost certainty.

Table 4. Budgetary reliability measures for refurbishment projects

Project Code	Elemental Cost Plan Sum (NZ\$)	Final Tender Sum (NZ\$)	Cost Difference (NZ\$)	Percentage Difference (%)	Year	Project Location	Procurement System Adopted
P16	2,266,000.00	2,522,725.36	256,725.36	11.33	2011	WLT	Traditional
P17	380,341.12	342,045.24	-38,295.88	-10.07	2010	AKL	Traditional
P18	666,000.00	866,725.36	200,725.36	30.14	2011	WLT	Traditional
P19	805,134.60	736,687.56	-68,447.04	-8.50	2010	AKL	Traditional
P20	2,023,490.94	2,233,773.04	210,282.10	10.39	2011	WLT	Traditional

Further analyses were carried out to determine the budgetary reliability of the elemental cost plan for procuring the different types of buildings previously analysed. *RMS* deviation measure was expressed mathematically in Equation 2. This was converted to a percentage measure through normalization adjustment in order to make it comparable to other measures. In Table 5, this is regarded as the adjusted *RMS* measure. Odeyinka et al. (2009) justified the relevance of the normalization process as the *RMS* values obtained in their study are more of the function of tender and final account figures. This is applicable to the current study regarding the comparison between elemental cost plan and final tender sum. Moreover, the adjusted values are relative values that are more comparable.

The fourth analysis is the *Rel. MAD* measure that was expressed mathematically in Equation 3. The results of these analyses are presented in Table 5. As shown in the Table, the normalized / adjusted *RMS* measure and *Rel. MAD* measure are moderately close. This indicates that the two measures are reliable for measuring the budgetary performance of the design stage elemental cost plan under study. From the Table, the reliability ranking based on the normalized *RMS* and *Rel. MAD* measures shows that the elemental cost plan is most reliable as a budgetary tool for procuring residential building projects (Ranked 1). This is followed by educational, commercial and refurbishment projects respectively (Ranked 2, 3 and 4). The reliability ranking showed that the elemental cost plan is least reliable as a budgetary tool for procuring maintenance or refurbishment projects. Meanwhile, it is important to note that this result reveals the level of threats involved in relying considerably on elemental cost plan as a budgetary tool. Besides the residential building projects with a budgetary reliability of $\pm 2.85\%$ that is quite reliable and acceptable, the deviation margins for other project types are quite significant. Hence, Quantity Surveyors need to attach some level of confidence limits to the estimate they give to project owners if interested in cost certainty. This is very important because the deviations observed are as a result of inherent risks in the design stage elemental cost plan development.

Table 5. Elemental Cost Plan (ECP) budgetary reliability measures of different building types

Building Type	RMS Measure (NZ \$)	Adjusted RMS Measure (%)	Rel. MAD Measure (%)	Reliability Ranking
Residential	119,924.48	3.00	2.85	1
Educational	3,129,255.85	9.15	7.75	2
Commercial	3,410,231.99	12.96	10.74	3
Refurbishment	176,956.90	17.16	14.09	4

Results and findings could be presented either in tables or figures for illustration purposes. These presentation modes could be adopted in the earlier and latter sections (2, 3, 4 and/or 5) when deemed necessary. The table caption should be numbered and positioned before the table as shown in Table 1.

5 Conclusion and Further Research

The aim of the study was to investigate the budgetary reliability of design stage elemental cost plan in procuring building projects using secondary data from completed building projects. This study therefore concludes within the limitations of the data set confined to New Zealand, that in traditional procurement where elemental cost plans are used, there are deviations between elemental cost plan sums and final tender sums. The percentage deviation ranges between -3.67% and +3.95% for residential building projects. It ranges between -3.98% and +12.15% in the case of educational buildings. Commercial buildings attract a range of -14.22% and +16.33%, while it ranges between -10.07% and +30.14% for refurbishment projects. This suggests that besides the residential projects with little and acceptable deviation, the deviations observed in other projects are very significant.

The study concludes further that the elemental cost plan was most reliable (*Rel. MAD* of 2.85%) as a budgetary tool in procuring residential projects. This was followed by educational projects (*Rel. MAD* of 7.75%) and commercial projects (*Rel. MAD* of 10.74%) respectively. The design stage elemental cost plan was found to be least reliable as a budgetary tool in procuring refurbishment projects (*Rel. MAD* of 14.09%). An awareness of the possibility of deviations in different project types in quantitative terms offered by this study makes the design stage elemental cost plan a relevant tool for risk management to avoid budget overrun. Further, given construction projects procured using the elemental cost plan in traditional procurement, inherent risks could be subjected to quantitative assessment and management. Hence, the observed deviation measures could offer a relevant background towards the application of risk management techniques in budgetary and cost control in order to avoid budget/cost overrun in construction projects.

Further development of the work reported here, when further data are collected and analysed, will provide information for the development of a predictive model for application in New Zealand. Future study could also explore a factor approach to the analysis of risks impacting variability between design stage elemental cost plan and final tender sum.

6 Acknowledgement

The authors gratefully acknowledge the research fund provided by the University of Auckland, New Zealand through its PReSS account to facilitate data collection for this study. The authors would also like to express their thanks to the same university for the award of doctoral scholarship to the corresponding author for his PhD research.

7 References

- Adafin, J., Wilkinson, S. and Rotimi, J.O.B. 2014. An Exploration of Theoretical Concepts and Methods for Assessing Risk Impacts on the Variability between Design Stage Elemental Cost Plan and Tender Sum. *CIB W107, Lagos, Nigeria*, International Council for Research and Innovation in Building and Construction.
- Aibinu, A.A. and Pasco, T. 2008. The accuracy of pre-tender building cost estimates in Australia. *Construction Management and Economics*, 26(12): 1257-1269.
- Akintoye, A. 2000. Analysis of factors influencing project cost estimating practice. *Construction Management and Economics*, 18(1): 77-89.
- Akintoye, A.S. and MacLeod, M.J. 1997. Risk analysis and management in construction. *International Journal of Project Management*, 15(1): 31-38.
- Allan, N., Yin, N. and Scheepbouwer, E. 2008. A Study into the Cyclical Performance of the New Zealand Construction Industry. *Christchurch, New Zealand*, 1 - 64.
- An, S., Cho, H. and Lee, U. 2011. Reliability Assessment of Conceptual Cost Estimates for Building Construction Projects. *International Journal of Civil Engineering*, 9:9 - 16.

- Ashworth, A. 2004. *Cost Studies of Buildings*. Pearson Education Ltd, UK.
- Ashworth, A. 2008. *Pre-contract Studies: Development Economics, Tendering and Estimating*. Blackwell Publishing Limited, UK.
- Ashworth, A. and Hogg, K. 2007. *Willis's Practice and Procedure for the Quantity Surveyor*. Blackwell Publishing Ltd, Oxford.
- Baloi, D. and Price, A.D.F. 2003. Modelling global risk factors affecting construction cost performance. *International Journal of Project Management*, 21(4): 261-269.
- Cheong, P. F. 1991. *Accuracy in Design Stage Cost Estimating*. Unpublished MSc Dissertation, National University of Singapore.
- Choy, W. K. and Sidwell, A.C. 1991. Sources of Variations in Australian Construction Contracts. *Building Economist*, 30(3): 25-30.
- Dent, C. 1978. *Construction Cost Appraisal*. George Godwin Ltd, London.
- Enshassi, A., Mohamed, S. and Abdel-Hadi, M. 2013. Factors Affecting the Accuracy of Pre-Tender Cost Estimates in the Gaza Strip. *Construction in Developing Countries*, 18(1): 73-94.
- Enshassi, A., Mohammed, S.A.M. and Madi, I. 2005. Factors Affecting Accuracy of Cost Estimation of Building Contracts in the Gaza Strip. *Journal of Financial Management of Property and Construction*, 10(2): 115 - 124.
- Gibson, W. J. and Brown, A. 2009. *Working with Qualitative Data*. SAGE Publications Ltd, London.
- Hlaing, N. N., Singh, D., Tiong, R.L.K. and Ehrlich, M. 2008. Perceptions of Singapore construction contractors on construction risk identification. *Journal of Financial Management of Property and Construction*, 13(2): 85-95.
- Jafarzadeh, R. 2012. *Seismic Retrofit Cost Modelling of Existing Structures*. PhD Doctoral, The University of Auckland, New Zealand.
- Joshua, O. D. and Jagboro, G. O. 2007. An Evaluation of the Impact of Risk on Project Cost Overrun in the Nigerian Construction Industry. *Journal of Financial Management of Property and Construction*, 12:37 - 44.
- Kirkham, R. 2007. *Ferry and Brandon's Cost Planning of Buildings*. Blackwell Publishing Ltd, UK.
- Ling, Y. Y. and Boo, J.H.S. 2001. Improving the accuracy estimates of building of approximate projects. *Building Research & Information*, 29(4): 312-318.
- Morrison, N. 1984. The accuracy of quantity surveyors' cost estimating. *Construction Management and Economics*, 2(1): 57-75.
- Nworgu, B. G. 2006. *Educational Research: Basic Issues and Methodology*. Wisdom Publishers Ltd, Nigeria.
- Odeyinka, H., Kelly, S. and Perera, S. 2009. An Evaluation of the budgetary reliability of bills of quantities in building procurement. *RICS COBRA*, RICS, University of Cape Town, South Africa, 435-446.
- Odeyinka, H. A. 2010. Assessing Risk Impacts on the Budgetary Reliability of Design Stage Elemental Cost Plan. Retrieved 11 June, 2014, from http://www.docstoc.com/docs/99896893/built_environment.
- Odeyinka, H. A. and Yusif, A. 2003. An Assessment of the Accuracy of Quantity Surveyors' Preliminary Cost Estimates in Nigeria. *Construction Engineering*, 18(1): 33 - 38.
- Odusami, K. T. and Onukwube, H.N. 2008. Factors Affecting the Accuracy of Pre-Tender Cost Estimate in Nigeria. *RICS COBRA*, RICS, Dublin Institute of Technology, Republic of Ireland, 1 - 10.
- Ogunlana, O. 1991. Learning from experience in design cost estimating. *Construction Management and Economics*, 9(2): 133-150.

- Oladokun, M. G., Oladokun, A.A. and Odesola, I.A. 2011. Accuracy of Pre-Tender Cost Estimates of Consultant Quantity Surveyors in Nigeria. *Journal of International Real Estate and Construction Studies*, 1(1): 39 - 52.
- Onukwube, H. N., Adenuga, O.A. and Enang, I.J. 2009. The Impact of Risk on Contractors' Pricing: A Study of Building Projects in Lagos State, Nigeria. *RICS COBRA*, RICS, University of Cape Town, South Africa, 114 - 127.
- Potts, K. 2008. *Construction Cost Management: Learning from Case Studies*, Taylor & Francis.
- Rezakhani, P. 2012. Classifying Key Risk Factors in Construction Projects. *Constructii Architectura* 62(58): 27-40.
- Seeley, I. H. 1996. *Building Economics*. Macmillan Press Ltd, UK.
- Smith, J. and Jaggard, D. 2007. *Building Cost Planning for the Design Team*. Elsevier, UK.
- Smith, J., O'Keeffe, N., Georgiou, J. and Love, P.E.D. 2004. Auditing Construction Costs During Building Design: A case study of cost planning in action. *Managerial Auditing Journal*, 19(2): 259-271.
- Taroun, A., Yang, J.B. and Lowe, D. 2011. Construction Risk Modelling and Assessment: Insights from a Literature Review. *The Built and Human Environment Review* 4(1): 87 - 97.
- Tsai, T.C. and Yang, M.L. 2010. Risk Assessment of Design-Bid-Build and Design-Build Building Projects. *Operations Research Society of Japan*, 53(1): 20-39.
- Winch, G. M. 2002. *Managing Construction Projects*. Blackwell Publishing, Oxford.
- Zou, P. X. W., Zhang, G. and Wang, J. 2007. Understanding the key risks in construction projects in China. *International Journal of Project Management*, 25(6): 601-614.

TENDER PRICE INDEX DEVELOPMENT: A CRITICAL LITERATURE REVIEW OF MODELS FOR PREDICTION

Kissi, Ernest; Adjei-Kumi, Theophilus; Badu, Edward
Department of Building of Technology, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Abstract

Tender price determination for every construction project remains a critical variables for a successful project delivery. For project participants it is the fundamental concept for which prices for project are appraised. Proper analysis of how much clients investment can afford within appreciable cost is hinged on the Tender Price Index (TPI), which gives and forecasts the average movement in building prices within a certain time frame and much treasured at design stage for effective cost planning. The need for cognizant effort by quantity surveyors in giving a realistic price for project remains crucial due to the extent that clients are willing to spend within their budget peripheral. In the domain of accurate tender price index prediction researchers over the years have conjectured divergent views due to variances of statistical method adopted and their interpretations. This paper reviews various models adopted for prediction of TPI as a way of establishing need for further studies that will ensure more accurate prediction. The findings indicate that a combination of two statistical tools give more accurate prediction. In addition, variables used varies from one model to another which was compounded with a common statistical problem of non-stationary. This suggest that variables for tender price index prediction continues to vary from one geographical location to another, this is due to dynamism in economic indicators. Consequently, the need for development of a robust model cannot be shelved in any developing countries due to the fact that these countries have unstable market conditions.

Keywords: Tender Price Index (TPI), Model, Prediction, Review

1 Introduction

Pioneers modeling discussion describe a model as a technique developed to reflect, by means of derived processes, adequately acceptable output and establish series input data (Seeley, 1996). Shafique and Mahmood (2004) posit that a model is an abstraction or a framework for analysis of a system. It assists researchers in unfolding more accurately to reality; it also aids them to describe, predict, test or understand complex systems or events. Thus, models often provide a framework for the conduct of research and might consist of actual objects or abstract forms, such as sketches, mathematical formulas, or diagrams. It involves simplified representations of real-world phenomena (Powell and Connaway, 2004). Consequently, in Tender Price Index (TPI) development, there have been a number of models that have been developed by previous studies. The need for more unbiased methods, and the benefits of quantitative predictive price models in general has been recognised in the construction industry (Li and Love, 1999; Ng *et al.*, 2000:2004) however, the search for more concrete model remains debatable among researchers as new statistical and econometric methods keep on

revolving. As a result, diversity of cost models of varying complexities have been devised by researchers. Statistical methods have been widely applied in TPI prediction, with Regression Analysis (RA) and Time Series (TS) being the most popular approaches. Vector Error Correction (VEC), Fuzzy Sets (Chang et al., 1997), Structural Equation (Akintoye and Skitmore, 1999) and Artificial Neural Network approaches (Williams, 1994). It must be noted that all these methods were adopted as a medium of exploring statistical or econometric methods that will give the best prediction accuracy. In addition, the adoption of any method for the development of any model is founded on availability of the said variables and the conditions existing within geographical context. Hence, the motivation of this study is to critically review the various model for the forecasting TPI.

2 Extant of Tender Price Index Model Development

2.1 Regression Method

Regression are mostly used to examine the relationship between variables. These variables are either dependent or independent and such their measuring effects are hooked on the estimated regression equation. Regression method was the first approach used in predicting of TPI and remains the most popular techniques in modelling of TPI (Bowley and Corlett, 1970; Ng *et al.*, 2004). McCaffer *et al.* (1983) developed a regression model in United Kingdom which was purposefully done to measure the disparity between the input and output price of building contractor. This produced more accurate predictions of tender price movements than the subjective approach (judgmental) current at that time. This model predicted the TPI of buildings during the early design stage. They provided estimates using a library of data containing rate, quantity and date for the constituent elements of previously constructed buildings, inflation indexes and statistical models. However, this model was predicting a set of data covering a period of 9 years, although the statistical result applies that their data straddling 6-6.5 years. On the other hand, Chau (1988) found out that, there was downward trend of TPI to Building Cost Index (BCI) ratio over a period of 16 years in Hong Kong. This shows that a downturn is expected in the output growth of the industry. In using the data from Florida Department of Transportation, Herbsman (1983), developed composite cost index, which was similar to McCaffer's (1983) prediction in terms of the exploratory variables used in the measuring of the industry's output. Runeson (1988) proposed a multiple regression model for forecasting building price movements. The dependent variables were market condition index, whereas the predictor variables included the level of building approvals (a measure of demand), the fixed capital formation of building (a measure of current capacity or output of the industry) and the level of unemployment (a measure of capital utilization). It was found that, the R² was very satisfactory (0.8556) and the average absolute error stood at 3.67%. However, a multiple regression model was not stable over time and its forecasting accuracy diminished. The Building Cost Information Service (BCIS) produced a 2-year forecast of TPI also based on a linear regression model. The input variables consisted of the building cost index, the amount of construction output as well as the amount of construction new orders. The resulting forecasts were then adjusted by using experts' judgment. A major problem in forecasting TPIs is the contractors' unpredictable reactions to changes in construction demand (Akintoye and Skitmore, 1994). Fitzgerald and Akintoye (1995) found that the TPI forecasts produced by BCIS have been generally over-optimistic, leading to systematic forecast error. The mean absolute percentage error (MAPE) of the forecast indices varied from 3.60% at the first quarter forecast horizon to 12.23% at the eight-quarter forecast horizon. By using an optimal linear correction to remove biases and regression proportions of forecast errors, the MAPE of the forecast value was reduced to 2.20% at the first-quarter forecast horizon and 10.52% at the eight quarter forecast horizon. Regression models provide accurate prediction of TPI

movement when price levels are steady that is, moving constantly upward or downward. However, construction prices are mostly affected by market conditions and can fluctuate radically. This is evident in recent world economic crisis, for instance in Ghana, it is very vivid as the cedi remains unstable. Several studies have also shown that the weakness of current models are due to changing economic situations, thus always lead to substantial errors (Taylor and Bowen 1987; Akintoye and Skitmore, 1994; Wong and Ng, 2010), and so have not produced satisfactory results in terms of predicting (Ng *et al.*, 2000). Consequently, Wisnowski *et al.* (2001) argued that, the candid causal relationships between the TPI and the associated variables cannot be revealed in the regression analysis (Yu, 2014).

2.2 Time Series

Time series analysis involves the identification of the nature of phenomenon represented by sequence of observation and forecasting. Box-Jenkins approach (Box and Jenkins, 1970) is the most common used because it offers a more structured way of choosing the specification of the model and estimating the parameters. This technique determines future trends based on past values and corresponding errors. Since a time series method only requires the historical data of forecast variable itself, it is widely used to develop predictive models. The time series method has been used to forecast Taiwan's construction cost indices (Wang and Mei 1998), building costs (Taylor and Bowen 1987), price index (Fellows, 1991; Goh and Teo, 1993; Goh and Teo, 2000; Goh 2005), cost index (Hwang, 2011) and tender price index (Fellows 1991; Ng *et al.*, 2000). In the study of Engineering News Record (ENR) of Construction Cost Index (CCI) by Williams (1994), time series method was compared with linear regression and neural network models with respect to predictability. Taylor and Bowen (1987), however, modelled the tender price index in South Africa which reflected movements in price that contractors charged their clients. Current statistical methods, such as univariate time series models, do not have expounding capability and suitability for short-term predicting (Goh and Teo 2000; Wong and Ng 2010). However, the univariate time series modelling assumes that recent trends to remain relatively steady, it might produce high forecasting errors when the trend discontinues within the projected timeframe (Tong and Lim, 1980). Besides, the limited structure in the time series approach makes them only suitable for short-term forecasting (Wong *et al.*, 2010). This further suggest time series models are not robust enough to endure economic pressure and such it predictive ability is questionable, thus unsuitable when explanation or reasoning is critical (Goh and Teo, 2000; Wong *et al.*, 2010).

2.3 Multivariate Discriminant Analysis

Multivariate Discriminant Analysis is similar to regression analysis, however, the dependent variables consist of classifications that are related to the linear combination of independent variables. Thus, in an attempt to advance the accuracy of TPI forecasts, Ng *et al.* (2000) in Hong Kong adopted the multivariate discriminant analysis for forecasting directional changes of the TPI by utilizing eight leading economic indicators. These indicators comprised the best lending rate, building cost index, composite consumer price index, gross domestic product (construction), implicit gross domestic product deflator, and money supply and unemployment rate. Two discriminant functions were derived in order to distinguish between 'upward', 'constant' and 'downward' index trends. However, under closer examination the study was uncertain on many fronts. Firstly, the definition of the "constant movement" category of tender price movement change over time. Thus there was constant movement as when the value of the tender price index is the same as the previous quarter (Yu, 2014). In addition, rationalization of the discriminant model by the holdout sample is contentious. The holdout sample selected the best lag periods for the economic indicators in the model. Therefore, the 'holdout sample' is not really held out from the model construction Yu (2014) further argued that the prediction

power of the model can be regarded as poor. Given the clear long term upward trend of the tender price index, the fair benchmark predictions of the direction change would be always upward, which would be correct in 65% of the cases, better than the 59.7% by the model.

2.4 Vector Correction Error

Econometric models were developed for predicting various economic and financial variables, little has been done in the construction industry especially in forecasting the tender price using the VEC modeling approach. Vector Error Correction (VEC) models are readily comprehensible and commonly used to empirically analyse the dynamic behaviour of macroeconomic variables (Price, 1998). This method is also preferred because of its dynamic nature and sensitivity to a variety of factors affecting the measured variable, while it takes into account the long-run equilibrium relationships among the variables in the system (Lutkepohl, 2004) and allows short-term forecasting errors to be eliminated efficiently (Allen and Morzuch, 2006). The forecasting accuracy of the VEC model was also compared with the Box–Jenkins and regression models using the same data set. The MAPEs of the forecast TPI for one quarter ahead generated by the VEC, Box–Jenkins and regression models were 2.9, 11.4 and 4.2%, respectively. It is thus found that the VEC model outperforms the Box–Jenkins and regression models and proved to be efficient and reliable in forecasting the short-to medium-term tender price movements. Wong and Ng (2010) in a similarly studies use vector error corrections by integrating the correlation of co-integration non-stationary variables, which gave better results.

2.5 Neural Network

Williams (1994) developed back-propagation neural network models to forecast the changes in the construction cost index for time spans of 1 month and 6 months ahead. Variables selected as inputs to neural network models include the percentage change in the construction cost index, the prime lending rate, the percentage change in the prime lending rate, the number of housing starts, the percentage change in housing starts and the month of the year related to. The output from the neural network models is compared with prediction made by exponential smoothing and simple linear regression. It was found that the exponential smoothing and regression models produced a sum of the squares of errors (SSE) equal to 2.45 and 2.65, respectively, whereas the SSE for the neural network was 5.31. The forecasts produced by the neural network model gave a greater error than either exponential smoothing or linear regression. It was concluded that construction cost indices could not be forecasted accurately by using the back-propagation neural network model. Similarly, Yu (2014) also argued that neural networks require massive amounts of data, although the difficulty in the explanation of the theory behind makes its disadvantage. However, there is an increasing trend toward the use of neural networks, this due to the extent that neural networks allows for more complex variables to be recognized and make it more flexible to use.

2.6 Structural Equation Model

Akintoye and Skitmore (1994) derived a structural equation model for forecasting TPI. The demand equation comprises the number claiming unemployment-related benefit, the manufacturing output price/input cost ratio, the real rate of interest and the quarterly gross national product. The supply equation comprises the quarterly TPI, the output per person employed in the construction industry, the quarterly building cost index, the working days lost by workers involved in operation of construction industry due to industrial disputes, the number of registered private contractors and the dummy variable to reflect the general increase in prices(see Table 1 at appendix). This model produces inaccurate results as changes in the coefficients of the structural demand and supply equations will change the coefficients of the equation. On the other hand a study done by Asano et al. (2008) using the equation data based

on Akintoye and Skimore (1994) model showed that some values of some coefficients differ and some variables are less significant statistically.

2.7 Integrated Approach

Ng et al. (2004) in further attempt to improve the accuracy, developed a building tender price index (TPI) forecasting model by combining the multivariate regression model with univariate ARIMA mode. This postulation agrees with Granger's (2001) study which suggested that the integration of techniques might further enhance the predictive ability. It was found that the forecasting accuracy between the regression model and time-series model appeared similar when used in a one-quarter TPI forecast. However, the forecasts were improved when the integrated model was adopted. For a two-quarter TPI forecast, the regression model was found to be the most accurate, whereas the time-series model was the worst. The integrated model improved the forecasting accuracy. However, the multivariate regression model still remains doubtful. The model was built on the levels rather than the growth rates of the TPI and other economic indicators, and many of them, including TPI, display strong upward trend, it is very feasible that the correlation is inaccurate (Yu, 2014). This due to the fact that no unit roots test or co-integration test was carried out.

2.8 Further Studies on TPI Modelling Forecasting

Li et al. (2006) observed that the main problem associated with existing methods being used for forecasting the TPI is the limited consideration of market conditions, particularly when the market is unstable. They proposed that the TPI was the power function of the ratio of demand over capacity of the industry, which represented the industry's economic condition. The model is represented by $TPI = \alpha (Demand/Capacity)^\beta$; $\beta = \text{should be greater than } 1 \text{ in order to give a slower reaction TPI to a lower ratio and a faster reaction to a higher ratio of demand over capacity; and } \alpha = \text{acts as a multiplier to generate the TPI as the desired index value}$. Actual quarterly demand in 2002 and 2003 and estimated capacities were used to forecast quarterly TPIs for those two years that were then compared to TPIs generated using completed project expenditures and expert opinions. It was found that the differences between actual and forecast TPIs ranged from 0.9 to 5%. However, Li et al. (2006) does not explain how the experts' views are formed or obtained. The description of the demand measures in their model is also brief, stating only that the "s-curve method was applied" to "workload data". Therefore, it is not possible to either replicate the demand measures or apply it to other countries. Furthermore, Ho (2013) in an attempt to forecast TPI for under incomplete information of the building project proposed the grey system theory. The grey system forecasting is based on a statistical method, which is similar to time-series method. However, in the construction industry, incomplete works do not give actual cost implication hence, using such data cannot be assumed to give accurate results. The forecasting power of this model depends on the identification of appropriate leading variables. However, the proven leading variables of tender price indices are not known. Moreover, the temporal relations of variables are ignored in this models.

3 Conclusion and Further Research

Tender Price index prediction is still evolving, however, as current economy condition remain very vague with anticipated difficulties, clients are searching for professionals who can give them value for their intend investment. For researchers, the search for appropriate tool for the improvement of the predictive power remains the ultimate agenda. From the review the following conclusion were drawn, that included:

- It is difficult to generalize the use of any of the models that were reviewed due to the fact that there are different economic factors or indicators that were used and data span adopted for the various studies were not the same;

- Although, in some cases similar data were used, the results differ from one model to another due to the statistical tools used;
- In addition, a lot of models were hinged on time series and other techniques, have major a problem of stationary. This further indicates an inadequate level of knowledge in statistics on the part of some of the researchers; and
- Furthermore, the use of integrated approach have so far been used by Ng et al. (2004). It thus, shows the robustness of combining two methods, however, there were some weakness (Yu, 2014).

Hence, this suggest that further studies should be carried out on using the integration approach by dwelling on Granger (2001) study which suggested that the integration of techniques enhances the predictive ability of a TPI model. This can be done by improving Ng et al, (2004) work or building a new statistical model based on the combination of two different tools.

4 Reference

- Asano, M., Tsubaki, H., Bhattacharyya, P. K., and Yu, M. K. (2008). 2A-2 An Application of Web-based Hybrid Approach of Neural Networks and the Linear Regression Model to the Water Supply forecast in *Tokyo District Statistical Society of Japan Computer Conference Papers*, (22), 27-30.
- Bowley, M., and Corlett, W. J. (1970). Report on the Study of Trends in Building Prices. *Ministry of Public Building and Works*. Directorate of Research and Information.
- Box, G. and Jenkins, G. (1970) Time Series Analysis Forecasting and Control, *Prentice Hall*, Englewood Cliffs, NJ.
- Building Cost Index Models (1997) *British Cost Information Service*, London
- Chang, N. B., Chen, Y. L., and Chen, H. W. (1997). A Fuzzy Regression Analysis for the Construction Cost Estimation of Wastewater Treatment Plants (I) Theoretical Development. *Journal of Environmental Science and Health Part A*, 32(4), 885-899.
- Chau, K.W. (1998) The Implications of the Difference in the Growth Rates of the Prices of Building Resources and Outputs in Hong Kong, Engineering, *Construction and Architectural Management*, 5(1), pp. 38-50.
- Fellows, R. F. (1991). Escalation Management: Forecasting the Effects of Inflation on Building Projects. *Construction Management and Economics*, 9(2), pp.187-204.
- Fitzgerald, E., and Akintoye, A. (1995). The Accuracy and Optimal Linear Correction of UK Construction Tender Price Index Forecasts. *Construction Management and Economics*, 13(6), pp. 493-500.
- Goh, B. H. (2005). The Dynamic Effects of the Asian Financial Crisis on Construction Demand and Tender Price Levels in Singapore. *Building and Environment*, 40(2), pp. 267-276.
- Goh, B., H., and Teo H., P. (1993) Building Tender Price and Forecasting Model in Singapore *RICS Research Paper Series 18* London Royal Institution of Chartered Surveyor
- Goh, B., H., and Teo H., P. (2000). Forecasting Construction Industry Demand, Price and Productivity in the Box–Jenkins Approach. *Construction Management and Economics*, 18(5), pp. 607-618.
- Herbsman, Z. (1983). Long-Range Forecasting Highway Construction Costs. *Journal of Construction and Management*, 109(4), pp.423-434.
- Hwang, S. (2011). Time Series Models for Forecasting Construction Costs Using Time Series Indexes. *Journal of Construction Engineering and Management*, 137(9), pp.656-662.
- Ho, P. H. (2013). Forecasting Tender Price Index under Incomplete Information. *Journal of the Operational Research Society*, 64(8), 1248-1257.

- Lutkepohl, H. (2004). Vector Autoregressive and Vector Error Correction Models. *Applied Time Series Econometrics*.
- Lin Y, Chen MY and Liu S. F (2004). Theory of Grey Systems: Capturing Uncertainties of Grey Information. *Kybernetes: The International Journal of Systems and Cybernetics* 33(2): pp.196–218
- Li, H. and Love, P.E.D. (1999) Combining Rule-Based Expert Systems and Artificial Neural Networks for Mark-Up Estimation, *Construction Management and Economics*, 17(2), pp.169-176.
- Li, X., Ogier, J., and Cullen, J. (2006). An Economic Modelling Approach for Public Sector Construction Workload Planning. *Construction Management and Economics*, 24(11), pp.1137-1147
- Powell, R. A., and Connaway, L. S. (2004). Basic Research Methods for Libraries, *Libraries Unlimited*, Westport, CT.
- McCaffer R., McCaffrey, M.J. and Thorpe, A. (1983) The Disparity Between Construction Cost and Tender Price Movements, *Construction Papers*, Chartered Institute of Building 2(2), pp.17-28
- Ng, S. T., Cheung, S. O., Skitmore, M., and Wong, T. C. (2004). An Integrated Regression Analysis and Time Series Model for Construction Tender Price Index Forecasting, *Construction Management and Economics*, 22(5), pp.483-493.
- Ng, S.T., Cheung, S.O., Skitmore, R.M., Lam, K.C. and Wong, L.Y. (2000) The Prediction of Tender Price Index Directional Changes, *Construction Management and Economics*, 18(7), 843-852
- Shafique, F. and Mahmood, K. (2010) Model Development as a Research Tool: An Example of PAK-ISEA Library Philosophy and Practice
- Runeson, K. G. (1988). Methodology and Method for Price-Level Forecasting in the Building Industry. *Construction Management and Economics*, 6(1), pp. 49-55
- Taylor, R.G. and Bowen, P.A. (1987) Building Price-Level Forecasting: An Examination of Techniques and Application, *Construction Management and Economics*, 5(1), 21-44.
- Wang, C. H., and Mei, Y. H. (1998). Model for Forecasting Construction Cost Indices in Taiwan. *Construction Management and Economics*, 16(2), pp.147-157
- Williams, T.P. (1994) Predicting Changes in Construction Cost Indexes Using Neural Networks, *Journal of Construction Engineering and Management*, ASCE, 120(2), pp. 306-320
- Wisnowski, J. W., Montgomery, D. C., and Simpson, J. R. (2001). A Comparative Analysis of Multiple Outlier Detection Procedures in the Linear Regression Model. *Computational Statistics & Data Analysis*, 36(3), pp.369-382.
- Wong, J. M., and Ng, S. T. (2010). Forecasting Construction Tender Price Index in Hong Kong Using Vector Error Correction Model. *Construction Management and Economics*, 28(12), pp.1255-1268.
- Wong, W. K., Bai, E., and Chu, A. W. C. (2010). Adaptive Time-Variant Models for Fuzzy-Time-Series Forecasting. *Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions*, 40(6), pp.1531-1542
- Yu, K. W. (2014). The Economics of Construction Price Inflation: Measurement, Output and Productivity (*Doctoral Dissertation*, UCL (University College London))

Appendix 1

Table 11. Summary of Review Models

Author	Method	Purpose	Weakness	Conclusion
McCffar et al., (1983)	Regression			Can be used when price level are steady constantly upwards or downward. Not suitable for unstable market conditions. Relationship of between TPI and the associate variables cannot be reveal. Non-stationary of variables.
	$\underline{TPI}_t = a + b + o_{t-4}$ BCI_t <p>a and b are estimated of the regression coefficients, O = building Cost Index</p>	Measuring disparity between the input and output price of building contractors	Short run supply was basis for curve in terms forecasting, indicating upward trend only. Prediction covered 9 years instead of 6 to 6.5 (Yu,2014)	
Chau(1998)	$\underline{LMI}_t = 0.8553 + 0.00912t$ TPI_t <p>where t is the time in quarters</p>	Relation of Labour and Material and Index (LMI) to TPI	Long run supply was basis for curve in term forecasting thus, long run indicates downwards trend only	
Ng et al (2000)	Multivariate Discriminant Analysis			It can be use where there are more than one variables from different units or sources
	$Z = -1.079 + 0.264BCI_{t-2} - 0.007BLR_{t-2} + 0.028CPI_{t-2} - 0.012GDP_{t-2} - 0.024GDPC_{t-3} + 0.0251GDPD_{t-2} - 0.080M3_{t-2} - 0.034UR_{t-2}$ <p>BCI= Building Cost Index, BLR= Best Lending Rate, CPI = Composite Consumer Price Index, GDP = Gross Domestic Product, GDPC = Gross Value of Investment in Building, Construction, Plant, Developers, Margin and Transfer Costs of Land and Buildings, IGDPD = Implicit Gross Domestic Product Deflator, M3= Money Supply Definition 3, UR= Rate of Unemployment.</p>	Predicting changes of a TPI of new buildings in Hong Kong	Handout sample was not held out from the model. Prediction power of the model show only upward trend. Under constant movement there was change over time, that was change in TPI	
Ng et al, 2004	Integrated Approach			

<p>(Time series and Regression)</p>	<p>$F = 0.512Ra + 0.488ARIMA = \text{period one forecast}$ $F = 0.647RA + 0.353ARIMA = \text{period two forecast}$ Régression Analysis $TPI = 66.6274 + 1.6115BLRT_{t-3} + 0.4746BCI_{t-1} - 0.3117CPI_t - 2.7375UR_t + 0.0932M3_t - 0.00215HSIVA_{t-1}$ ARIMA $TPI_t - TPI_{t-1} = e_t + 0.7312e_{t-1} + 0.47e_{t-2}$ BCI = Building Cost Index, BLR = Best Lending Rate, CPI = Composite Consumer Index, M3 = Money Supply Definition 3, UR = Rate of Unemployment, and HSIAV = Hang Seng Index 100 days Moving Average</p>	<p>Forecasting TPI</p>	<p>No root or co-integrated test was carried out. Model was built on level rather than the growth rate of TPI and other economic indicators. Handout sample was not held out from the model. Prediction power of the model show only upward trend.</p>	<p>The need to introduce a variable for validation was not done. Differencing test was also not done to bring variables to stationary (Box-Jenkin, 1970).</p>
<p>Taylor and Bowen (1987)</p>	<p>TIME SERIES, $P_t = \text{Price index at time } t$, $d = \text{difference operation}$, $ln = \text{natural logarithm operator}$ $dlnP_t = \text{is an approximation of the grow rate of the price } P \text{ over the time } t$</p>		<p>Tender Price Index based on information return from QS firms</p>	<p>Suitable for short term forecasting.</p>
<p>Fellow 1999:1988</p>	<p>ARIMA (0, 1,2)-BCIS $dP_t = 1.161 + 1.33dP_{t-1} - 0.473dP_{t-2} + e_t$ ARIMA (0, 1,1) : PSA $dP_t = 0.673 + 0.8891dP_{t-1} + e_t$ ARIMA (0, 1,3) $dP_t = 1.254 + 1.4425dP_{t-1} - 0.7963dP_{t-2} + 0.2063dP_{t-3} + e_t$</p>	<p>BCIS : All-in tender price index PSA : tender price index Davis, Belfield and Everest Tender Price Index</p>	<p>The variables were non-stationary meaning that either mean or variance of the variables are not constant over time.</p>	<p>Errors are forecast when the estimated trend discontinues within the projected timeframe.</p>

Goh and Teo 1993	ARIMA (0, 1,1) $dP_t = -0.38399dP_{t-1} + e_t$	Public industrial buildings tender price index	The indices over time display upward trends indicating that at least means of these indices are not constant	
Goh and Teo,2000	ARIMA (0, 1,1) $dP_t = -0.3864dP_{t-1} + e_t$	Public industrial buildings tender price index		
Goh,2005	ARIMA (0, 1,1) $dP_t = -0.08251dP_{t-1} + e_t$	Building and Construction Authority (BCA)		
Wong and Ng, 2010	Vector Error Correction			
	$\Delta tpi_t = 0.0034 - 0.0737 (longrunrelationship) + 0.39\Delta tpi_{t-1} + 0.05\Delta tpi_{t-2} + 0.04\Delta tpi_{t-3} - 0.06\Delta tpi_{t-4} + 0.32\Delta bci_{t-1} - 0.11\Delta bci_{t-2} + 0.21\Delta bci_{t-3} + 0.12\Delta bci_{t-4} - 0.10\Delta gdp_{t-1} - 0.08\Delta gdp_{t-2} - 0.12\Delta gdp_{t-3} - 0.14\Delta gdp_{t-4} - 0.04\Delta gdp_{t-1} + 0.04\Delta gdp_{t-2} + 0.17\Delta gdp_{t-3} + 0.03\Delta gdp_{t-4}$ <p>where tpi_t is log of quarterly tender price index of building industry in Hong Kong at time t; bci_t is log of quarterly building cost index at time t; gdp_t is log of quarterly gross domestic product at time t; gdp_{ct} is log of the quarterly construction component in gross domestic product at time t;</p> <p>Δ is the first difference operator such that $\Delta tpi_t = tpi_t - tpi_{t-1}$</p> <p>for <i>long run relationship</i> in their preferred model is as follows:</p> $= tpi_{t-1} + 1.81bci_{t-1} + 1.88gdp_{t-1} - 0.03gdp_{ct-1}$ <p>That is for long run co-integrating equation as follows</p> $tpi_{t-1} = -1.81bci_{t-1} - 1.88gdp_{t-1} + 0.03gdp_{ct-1} + e_{t-1}$ <p>Where e_{t-1} is a white noise random variable with a constant variance and zero mean.</p>	For predicting TPI in Hong Kong first quarter of 1983 and first quarter of 2006	The used of negative coefficient of bid was not explained. From the equation the higher the building cost index the lower the TPI. Which is not normal, but the author did not explain what might have cause for such occurrence.	It is use to correct the ARIMA error of stationary

Akintoye and Skitmore,1994	Structural Equation			
<p>$TPI_t = -3.615 + 0.807 \ln BCI_t + 0.009 \ln STR_{t-4} - 0.296 \ln PRO_{t-2} - 0.258 \ln FRM_{t-5} + 0.003 RIR_{t-3} + 0.542 \ln MAN_{t-7} - 0.136 \ln EMP_{t-2} + 0.606 \ln GNP_t + 0.061 OIL_{t-1}$</p> <p>SUPPLY</p> <p>$\ln QS_t = 1.049 + 0.970 \ln TPI_t + 0.628 \ln PRO_{t-4} - 0.695 \ln BCI_{t-2} - 0.019 \ln STR_{t-3} + 0.239 \ln FRM_{t-8} - 0.093 OIL_{t-1}$</p> <p>DEMAND</p> <p>$\ln QD_t = -14.051 - 0.766 \ln TPI_{t-3} + 1.632 \ln GNP_t - 0.011 RIR_{t-1} - 0.249 \ln EMP_{t-4} + 1.764 \ln MAN_{t-4}$</p> <p>EQUILIBRIUM</p> <p>$\ln QS_t = 3.281 + 0.197 \ln QD_t + 0.158 \ln QD_{t-1} + 0.106 \ln QD_{t-2} + 0.055 \ln QD_{t-3} + 0.02 \ln QD_{t-4} + 0.016 \ln QD_{t-5} + 0.058 \ln QD_{t-6}$</p> <p>TPI:BCIS quarterly tender price index deflated by retail price index, BCI: BCIS building cost index deflated by retail price index, STR: number of strikes or stoppages, PRO: labour productivity, FRM: number of construction firms, RIR: real interest rate, MAN: profit margin in manufacturing sector, EMP: level of unemployment, GNP: Gross National Product deflated by retail price index, Oil: Oil crisis dummy</p>	Forecasting price index based on demand and supply curves	Changes in the coefficients of the structural demand and supply equations will change the coefficients of that equation making it inaccurate for forecasting.	Variables were not tested for stationarity, e.g. The TPI and GNP for the supply equation	

TOWARDS AN INTEGRATED SUSTAINABLE PROCUREMENT MODEL FOR THE NIGERIAN CONSTRUCTION INDUSTRY: A REVIEW OF STAKEHOLDERS’ SATISFACTION WITH CURRENT REGIMES

Ogunsanya, Oluwabukunmi Ayopo; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington
Department of Construction Management and Quantity Surveying, Faculty of Engineering and Built Environment, University of Johannesburg, Johannesburg, Gauteng, South Africa

Abstract

Procurement of public works in Nigeria has been plagued by several ills. Principal amongst these are; inadequate management of the highly competitive contractual relationships, prolonged project time, failing of infrastructure in serviceability requirements, extreme cases of frequent buildings collapse long before the design life has expired and controversial claims. The incidences or accusation of collusion among parties which are detrimental to the projects are burning issues among the Nigerian construction professionals and academics. The aim of this study is to explore stakeholders’ satisfaction with the current procurement methods in construction project delivery in the country. The objectives of the research are; to identify stakeholders’ expectations for procurement performance in the Nigerian Construction Industry and to explore the level of stakeholders’ satisfaction with the procurement methods used. The research employs an exploratory qualitative research approach. 45 respondents who are stakeholders in the construction industry identified through purposive sampling were interviewed. The findings showed that the current methods have not delivered intended benefits to the spectrum of stakeholders. The study concluded that there exists a gap in stakeholders’ expectation of performance regarding total project costs, time of delivery, value derivable from projects in their service life and the actual project delivery in the Nigerian Construction Industry. Thus, in developing a sustainable procurement model, stakeholders’ perspective is important. Stakeholder’s support and buy – in are important being potential users of the new model. Their input, critic and aspirations are necessary ingredients.

Keywords: Construction Industry, Satisfaction, Stakeholders, Procurement, Project

1 Introduction

Construction procurement has become of concern and attracted industry-wide attention considering its critical role in the delivery of intended benefits to project stakeholders (Association for Project Management, 2006). The Construction Industry has struggled to deliver real value to its clients when compared to other industries. This phenomenon scholars argue is largely due to the poor performance of the procurement strategy (Dada, 2012; Dim and Ezeabasili, 2015). According to Love, Skidmore and Earl (1998), procurement performance is a direct measure of the construction industry performance. It is believed that a good procurement is synonymous with successful project performance (Rwelamila, 2010). Hence, Watermeyer (2011) found it appalling, the unwillingness of developing countries and the

paucity of efforts at developing procurement strategy that will deliver better results than currently experienced. Ofori (2000) posits that part of the challenges of procurement in developing countries is that most of the methods used are imported from the developed nations that have different history, culture, technological development and size of industry. Thus, in developing an integrated procurement model for the construction industry in Nigeria, there is need to evaluate stakeholder satisfaction with current methods. This study builds on the works of Dada (2013); Adejo and Babalola (2013); Ekung, Okonkwo and Odesola (2014) and Omonori and Lawal (2014). The existing studies focused on stakeholder's view of success factors and their engagement on construction projects in the industry. Hence, there exists a gap of an industry-wide inquiry of stakeholders' satisfaction with current methods. The aim of the study is to evaluate stakeholders' satisfaction with the current procurement processes in construction project delivery. The objectives of the research are; to identify stakeholders' expectations for procurement performance in the Nigerian Construction Industry and explore how satisfied the stakeholders are with the procurement methods used in the country. This new study contributes to existing knowledge by providing useful insight into different stakeholders experience as regards construction procurements in Nigeria.

2 Construction Procurement and Stakeholders' Satisfaction

2.1 Construction Procurement

Love *et al.* (1998) argue that procurement is a key factor in attaining client satisfaction and project success. Love, Irani, Cheng, and Li (2002) and Rwelamila (2010) define procurement as "an organisational system that assigns specific responsibilities and authorities to people and organisations, and set out how different elements of a construction project would relate". Also, Greenwood and Walker (2002) describe procurement systems as an arrangement comprising of at least four distinguishable elements:

1. Organization of inputs for the project (how the project will be executed);
2. Relationships of the participants;
3. Reimbursement regimes for participants; and
4. Contractual arrangements.

The definitions above show that procurement entails complex interaction of several components that ultimately determine how construction projects are delivered. The variants of procurement systems used today stem from the need to improve on construction project delivery gains (Babatunde, Opawole, and Ujaddugbe, 2010). Consequently, the selection of the most suitable procurement system is critical for clients and project participants. Thus, an important and contemporary issue for industry practitioners and academics. Construction Procurement methods are broadly classified into Traditional and Non-Traditional types.

2.2 Procurement methods

Literature has identified more than 12 procurement routes through which construction projects can be delivered. These are; Traditional, Design-Build, Construction Management, Management Contracting, Labour Only, Direct Labour, Public Private Partnerships, Partnering, and Strategic Alliance etc. These procurement methods have been classed as traditional and non-traditional types. Traditional procurement method handles the design and construction of a project in two separate phases and by two separate teams (Masterman, 2002; Mbamali and Okotie, 2012). Using this approach, the Client enters into separate contracts with the design team as consultants to produce necessary designs and contract documents. Afterwards, the client signs a separate agreement with the contractor to deliver the project based on agreed criteria. The Client selects a contractor through a tendering process that may

be open, selective or negotiated (Odusami and Bamisile, 1997; Mathonsi and Thwala 2012). The non-traditional types are: Integrated, Management Oriented, and Collaborative/discretionary procurement systems. These are exemplified as Packaged Deals, Turnkeys, Design and Build, Build Operate Transfer (BOT), Design Build Operate Transfer (DBOT); Management Contracting, Construction Management; Public Private Partnerships, Private Finance Initiatives, Partnering, Strategic Alliancing, Concessions, Framework Agreements (Latham, 1994; Rwelamila, 2010).

2.3 Procurements in Nigeria Construction Industry

For over 45 years after Nigeria's independence, there was no proper legal framework that regulated procurement in the public sector. Procurements were done based on individual policies of each agency of government fraught with irregularities and corruption. Contracts were awarded based on personal recognition and political office holders used contract awards to settle cronies and families. Succinctly, the World Bank Country Procurement Assessment found:

“fraudulent practices in the award and execution of public contracts through inflation of contract cost, lack of procurement plans, poor project prioritization, poor budgeting processes, lack of competition and value for money and other kinds of manipulations of the procurement and contract award processes” (Bureau of Public Procurement, 2015).

In order to mitigate these challenges, the Public Procurement Act of 2007 was promulgated. Thus, Bureau of Public Procurement (BPP) was established in Nigeria to provide a legal/institutional framework and develop professional capacity for public procurement in Nigeria. The framework covered procurement of goods, works and services. The PPA entrenches the two stage traditional procurement method. This entails the pre-qualification of contractors (technical qualification, financial capability, experience in the industry, adequate personnel, equipment etc.) and financial bidding to select the lowest and most responsive bidder (Adejo and Babalola, 2013).

Consequently, the main legal frameworks guiding public procurement in Nigeria are Public Procurement Act (PPA), 2007 and Infrastructure Concession Regulatory Commission Act (ICRCA), 2005. The PPA has been criticized for failing to deliver on value for money, transparency, as intended by major stakeholders in the industry due to factors such as failure of the Government to constitute the National Council for Public Procurement and incompetency of procurement officers in running the process. Some successes have however been recorded (Jacob, 2010; Williams–Elegbe, 2012; Bureau of Public Procurement, 2015).

Babatunde, *et al.* (2010) acknowledge the use of both traditional and non-conventional procurement methods in the Nigerian Construction Industry. The study reveals 48.08% of respondents use variants of traditional procurement, 32.69% variants of public private partnership and 19.24% Design and Build methods. The factors that ranked highest in the selection of traditional methods are project completion at estimated time and cost. While the factors that ranked highest in the selection of non-traditional methods are quality assurance and project completion at estimated time.

The Construction Industry Stakeholders in Nigeria have been identified as Architects, Engineers, Project Managers, Builders, Quantity Surveyors, Governments, Local communities, Suppliers and Financial Institutions (Adejo and Babalola, 2013). Depending on where the projects are located, the local communities are usually willing to accept construction projects geared towards infrastructure development due to years of lack and underdevelopment in certain parts of Nigeria. However, matters of land tenure system, acquisition, adequate compensation, environmental degradation and local participation in terms of employment for the host communities are front burners when it comes to new developments. Experience have

shown that certain social projects such as schools, boreholes, municipal treatment plants, roads, markets, mass housing were poorly delivered (Ekung, *et al.* 2014; Omonori and Lawal, 2014).

2.4 Stakeholder Theory and Construction Project Stakeholders

There is a consensus among many researchers that what is known as “Stakeholder Theory” has its roots in the works of Freeman (1984). Freeman argues that at the organizational level, stakeholder management has a tripartite function. These are: identification of stakeholders, the development process that recognises their needs cum interests and cultivating relationships with them in line with the corporate objectives of the company. Clarkson (1995) asserts that stakeholders can be broadly categorized into two groups. The primary and the secondary groups. Stakeholders that have an official or contractual relationship with an organization such clients, employees, suppliers, and shareholders belong to the former while those not holding such contracts such as government, local community are the latter. Hirsh and Morris (2010) agree with this position.

Turner (1999) opines that “stakeholders” are all the people or groups whose lives or environment are affected by the project but who receive no direct benefit from the project. This includes; teams family members, people made redundant by the product of the project, and local community where the project is based. Association for Project Management (2006) views stakeholders as all those who have interests or roles in the project or are impacted by the project. Project stakeholders according to Anderseen (2008) are individuals or groups of people affected by a project or in a position to influence it. These individuals may not have official roles to play on the project. Project Management Institute (1996) defines project stakeholders as individuals or organizations who are actively involved in the project or whose interest may be positively or negatively affected as a result of executing the project.

Despite the above views, Mairnades *et al.* (2011) strongly posit that there is yet a lot of uncertainties as regards the term “stakeholders”. The authors concern stems from delimitation for the word “stakeholder”. Who and who are stakeholders indeed? The authors argue that there exist several definitions for the term, therefore creating confusion as to what the term means. Supporting this position, Friedman and Miles (2006), asserts that the term “stakeholder” has been inappropriately used in the past 20years. Though, the term is popularly used by governments, businesses, non-governmental bodies and the Media, there exist more than 60 different concepts and meanings associated with the term “stakeholder” (Bryson, 2004; Beach 2008). Thus, there is an ongoing debate as regards the merits and demerits of the stakeholder theory or whether it is a theory at all (Jones and Wicks, 1999 and Donaldson, 1999).

Nonetheless, the common principle that ran through most of the concepts or definitions is that the Company should take into consideration the needs, concerns and influences of persons or groups who either impact or are impacted by its policies (Federick, 1992). At the organisational level, Cleland (1999) argue that one of the key functions of managers is to develop an organizational structure for a project. This function can be achieved by identifying appropriate stakeholders, specifying the nature of their interest, measuring stakeholders’ interest, predicting the future behaviour of each stakeholder, and evaluating the impact of the stakeholders’ behaviour on the team’s ability to manage the project (project politics).

Eskeroid and Hueman (2013) contest that addressing the needs and challenges of the society entails identifying and managing the needs of stakeholders. The authors suggest that for effective stakeholder management to occur which satisfies the requirements of sustainable development, the following questions require answers;

- a) Does value determine the basis of decisions e.g. participation, transparency or fairness?
- b) How will the needs of the stakeholders be balanced within the economic, environmental and social interests?

- c) To what extent will the values and perspectives of the stakeholders be considered in the short, medium and long-term basis? What of future stakeholders?
- d) How far-reaching will the inclusion be in terms of spatial consideration (Gareis, Huemann, and Martinuzzi, 2013) i.e. local, regional, and global stakeholders?

Elkington (1998) uses the term “Triple Bottom Line” to convey the financial, social and environmental performance of a project. The author asserts that sustainability could be achieved at the intersection of the environmental, social and financial performance of a project. This is a necessary trade-off for a practicable result (Doloi, 2012). Boyd (2011) views project stakeholders as customers who are either users of the product of the project or those who pay for the project. These stakeholders can be internal or external to the project. It is the project stakeholders that determines whether a project is successful or not depending on the agreed parameters at the beginning of the project and the final project results.

2.5 Project Stakeholders satisfaction

A prominent view in marketing literature as regards customer satisfaction is the GAP model. The model explains that a company must understand its customer expectations and measure its performance against those expectations (Parasuraman, Zeithaml, and Berry, 1985). Strong, Ringer and Taylor (2001) applied the model to the wider field of stakeholder management. The study reveals that timeliness of communication, honesty, completeness of information, the empathy shown by management and treatment of all stakeholders with equity are critical to stakeholder satisfaction.

Satisfaction is identified as one of the challenges of the Construction Industry (Dulaimi, 2005; Nzekwe-Excel, 2012). Traditionally, project team satisfaction derives from meeting the needs of the Client. However, with recent developments in the industry, satisfaction has been redefined as meeting the needs of the clients and other project participants. Construction Industry Development Board (2008) included contractor satisfaction as one of the measures of Construction Industry performance in South Africa. Thus, the success of projects regarding stakeholders’ satisfaction is expressed as the extent to which requirements, needs, and expectations of the Client and other project participants are met i.e. key stakeholders.

Boyd (2011) believes there are satisfiers and dissatisfiers that impact on the overall satisfaction of the customer. A satisfier is a project deliverable that if achieved will affect the customer satisfaction positively while a dissatisfier is that which will affect the customer satisfaction negatively if it is not achieved. Thus, highlighted the Maxims of project satisfaction as;

- i. Implicitly or explicitly delivering the products that the stakeholders needs or desires
- ii. Offering products at quality consistent with the prices
- iii. Making projects available in the timeframe specified by the customers
- iv. Providing appropriate feedback mechanism
- v. Instituting a conflict resolution process that is fair to all the stakeholders.

The APM (2006) defines project success as the satisfaction of stakeholders’ needs and thus measured by the success criteria identified and agreed upon at the start of the project. Lim and Zain (1999) explain that from project participant’s perspective, project success is construed as the attainment of some established project goals while public or end users perceive project success from satisfaction derivable from the project. Thus, Cleland and Ireland (2004), thought it not strange to see different stakeholders express success/satisfaction from their view point.

Hence, Construction Industry Satisfaction Constructs are Cost, Quality, Time and Utility in a healthy and safe environment (Rwelamila, 2010; Nzekwe-Excel, 2012). Rwelamila (2010) posits that different project procurement systems have varying degrees of impact on meeting

certain stakeholder expectation. These expectations could range from contractor collaboration during the design process, client involvement, reduction in variation, constructability, value engineering, risk sharing and allocation, public accountability to a host of others. The author argued that when the desires of key stakeholders cannot be met by the proposed procurement system an alternative or a variant may be appropriate. Thus concluded that there is a lack of adequate knowledge of procurement systems by construction experts which has been a source of numerous project failures.

In a survey study, Dada (2013) identified that there is no significant difference between the expectation of contractors and clients as regards using the following as parameters for measuring satisfaction in the Nigerian Construction Industry: project completion at expected time, project completion meeting and exceeding agreed quality specifications, project completion at expected cost, transparency and accountability, potential for providing technology transfer, completion for prestige and status symbol.

It is easier to evaluate what stakeholders want at the project level because there is an established technique to do so. The stakeholder analysis is a technique that helps to identify project stakeholders, discern their values, beliefs, expectations and group their level of influence on the project. Thus, at the end of the project the level to which the needs or aspirations of the key stakeholders have been met can be established. However, at the industry level there is much complexity. Stakeholders' satisfaction requires making comments through the aggregation of experiences on numerous unrelated projects. This scenario in itself posed challenges for the research. The paper progresses to the methodology for the research.

3 Research Methodology

This research employs an exploratory qualitative approach. The choice of research methodology was determined by the ontological and epistemological basis of the research and position of literature. Thus, it is important to discuss what constitutes a qualitative research. There are many positions in literature as to what qualitative research entails. However, Mason (2002) succinctly describes qualitative research as that with the interpretivist philosophical approach. Its data generation processes are flexible and sensitive to social context in which the data is produced. Methods of data analysis involves case building which consist of understanding of complexities, details and context. This position is supported by Creswell (1994) and Saunders, Thornhill, and Lewis (2003). It suffices to say, that certain quantitative researchers view qualitative research as less systematic and anecdotal or at best illustrative. Sufficient proof exists in literature that shows that this position is far from the truth. The strategic significance of context and in-depth understanding of the social world remains obvious strengths of the qualitative research.

Key stakeholders in the Nigerian Construction Industry were identified through purposive sampling and interviewed. 45 interviews were conducted. The participants were based in two major Nigerian cities of Lagos and Abuja. The choice of location is due to the concentration of construction activities at these locations. The researcher obtained the consent of the participants regarding their willingness to partake in the study and were informed it is part of an ongoing doctoral research. The interviews were conducted via telephone, thus audio recorded and transcribed for analysis. Table 1 contains list of interviewees according to the stakeholder types.

Table 1. Categorization of interviewees according to stakeholder types

Type of stakeholder	No of interviewees
Government Agency/Procuring Authority	6
Private Sector Client Organization	5
Construction Professionals (Architect, Engineers, Builders, Quantity Surveyors)	12
Construction Companies	8
Informed members of the public	7
Financial Institutions	3
Suppliers	4
Total	45

4 Findings and Discussion

The cross section of respondents admitted to using Traditional, Labour only, Direct Labour, Construction Management, Management Contracting at one time or the other but with limited experience with Design and Build and PPP methods. The interviewees said that it is the clients that determine most of the time the choice of procurement option ably assisted by the consultants after consideration of a host of factors. However, public construction projects delivery at Federal and State levels are governed by the Public Procurement Act, 2007.

The perception of informed members of public concerning the performance of the construction industry regarding its delivery on the cost, quality, time of delivery, and utility basis is less than satisfactory. Projects meant to be delivered within a reasonable period of time get unduly delayed. According to this category of respondents, project costs nearly always escalates. It is common for roads newly constructed to start having potholes within few years of their use. Delivery and maintaining good quality projects have been a challenge. The government hardly carry the public along with good information as regards public infrastructure projects. This in line with the position of Strong *et al.* (2001) with claims that timeliness of communication, the correctness of information, honesty, and a sense of being treated equally affect satisfaction significantly.

Private Sector clients use a wider range of procurement options than the public sector though the public sector is the bigger client. Certain principles such as public accountability, competitive bidding make some procurement options less desirable. Example of such are Cost reimbursable variant of traditional method and Partnering. This is because the tax paying public are less comfortable with the idea of no financial ceiling for projects and fear monopoly in the market. This situation necessitates choosing the most appropriate procurement system and thus impact on stakeholder satisfaction (Rwelamila, 2010). The private sector clients have achieved better delivery of projects because funds are more readily available, delivery of projects are fitted to business outcomes, there is more discipline as regards use of funds, and risk management. The private sector clients feel satisfied with the current methods.

The Professionals' perspective is that more needs to be done concerning choosing appropriate procurement methods to suite the project specifics. The current challenge with funding of national budget has made Public Private Partnership (PPP) a desirable model for government at all levels. However, the PPP is still hardly open enough for scrutiny as there are few of such projects in the country. Most of these projects are still at construction stages. The Financial Institution respondents and Suppliers have been at the receiving end of the imperfection in the industry. These two groups facilitate delivery of projects through the provision of funding, warehousing of funds, provision of performance guarantees and supplying materials. Instability

in the industry affect both groups negatively. The perspectives of the two groups is that while the construction industry has potential for employment generation and increased liquidity, it has performed below expectation. The Construction Company senior management respondents identify delays in payment by Clients, non-effective judicial system for pursuing claims when clients defaults, financial strain in the economy as factors influencing effective procurements. The contractors lament the loss of margin due to stoppage of funding to some projects. Thus admitted the industry can perform better than it is currently in meeting stakeholders' expectation.

5 Conclusion

The study explores stakeholder satisfaction with current procurement regimes in the Nigerian Construction Industry through a quota sampling of key industry stakeholders. The study reveals that there exists a gap in stakeholders' expectation of performance of construction projects and the actual project delivery in the Nigerian Construction Industry in terms of cost, schedule, quality and utility. It suffices to say that satisfaction is low when the spectrum of stakeholders is considered. Thus, in developing a sustainable procurement model, stakeholders' perspective is important. The current research is part of an ongoing research, so the findings of the research will help direct future research in developing a procurement model that will be tailored made to the realities of the Nigerian Construction Industry.

6 References

- Adejo, C.O. and Babalola, A.A. (2013). Cost and Time Performance of Construction Projects under the Due Process Reform in Nigeria. *Research Inventory: International Journal of Engineering and Science*, 3(6), pp. 1-6.
- Andersen, E.S. (2008). *Rethinking Project Management: An Organisational Perspective*. Harlow: Prentice Hall/ Financial Time.
- Association for Project Management (2006). APM Body of Knowledge. 5th edn., Buckinghamshire, APM.
- Babatunde, S.O., Opawole, A., and Ujaddugbe, I.C. (2010). A Review of Project Procurement Methods in Nigerian Construction Industry, *Civil Engineering Dimension*, 12, pp 1-7.
- Beach, S. (2008). Sustainability of Network Governance: Stakeholders Influence. Proceeding of Contemporary Issues in Public Management. *The 12th Annual Conference of International Research Society for Public Management (IRSPM XII)*, Copenhagen Business School, Fredericksberg, April 2008.
- Boyd, A. (2011). The Five Maxims of Project Satisfaction. *Aslib Proceedings*, 53(10), pp. 423 – 430.
- Bryson, J. (2004). What to do when Stakeholders Matter? *Public Management Review*, 6(1), pp. 21- 53.
- Clarkson, M. (1995). A Stakeholder framework for Analysis and Evaluating Corporate Social Performance. *Academy of Management Review*, 20(1), pp. 92-117.
- Cleland, D.I. (1999). *Project Management Strategic Design and Implementation*. 3rd edn., Singapore: McGraw-Hill.
- Cleland D.I and Ireland I. (2004). *Project Managers Handbook*. 2nd edn., New York: McGraw-Hill.
- Creswell, J. W. (1994). *Research design: Qualitative and Quantitative approaches*. pp. 8-10, California: Sage Publications.
- Construction Industry Development Board (2008). *The Construction Industry Indicators Summary Report: 2008*, CIDB, pp. 2-4.
- Dada, M.O. (2012). Predictors of procurement selection: An investigation of traditional and integrated methods in Nigeria. *Journal of Construction in Developing Economies*, 17(1), pp. 69 -83.

- Dada, M.O. (2013). Expected Success Factors for Public Sector Projects in Nigeria: A stakeholder Analysis. *International Journal of Organisation, Technology and Management in Construction*, 5(2), pp. 852 -859.
- Doloi, H. (2012). Assessing Stakeholders Influence on Social Performance of Infrastructure Projects. *Facilities*, 30(11), pp. 531 -550.
- Donaldson, T. and Preston, L.E. (1995). The Stakeholder Theory of Corporation: Concepts, Evidence and Implications. *Academy of Management Review*, 19(2), pp. 252- 282.
- Donaldson, T. (1999). Response: Making Stakeholder Theory Whole. *Academy of Management Review*, 24(2), pp. 237–241.
- Dulaimi, M.F. (2005). The Challenge of Customer Orientation in the Construction Industry. *Construction Innovation*, 5(1), pp. 3-12.
- Dim, N. U. and Ezeabasili, A.C.C. (2015). Strategic supply chain framework as an effective approach to procurement of public construction projects in Nigeria. *International Journal of Management and Sustainability*, 4(7), pp. 163-172.
- Ekung, S.B. Okonkwo, E. and Odesola, I. (2014). Factors Influencing Construction Stakeholders Engagement Outcome in Nigeria. *International Letters of Natural Sciences*, 20, pp. 101 – 114.
- Elkington, J. (1998). Partnerships from cannibals with Forks: The Triple Bottom Line of the 21 Century. *Business, Environment and Quality Management*, 11, pp. 130 – 141.
- Eskeroid, P. and Huemann, M. (2013). Sustainable Development and Project Stakeholder Management: What the Standard says. *International Journal of Managing Project and Business*, 6, pp. 36-50.
- Frederick W., Post, J. and St. Davis K. (1992). *Business and Society: Corporate Strategy, Public Policy Ethics*. 7th edn., New York: McGraw-Hill.
- Gareis, R Huemann, M and Martinuzzi A. (2013). *Rethinking Project Management with Sustainable Development Principles*. Project Management Institute, Newton Square, P.A.
- Gibson, K. (2000). The Moral Basis of Stakeholder Theory. *Journal of Business Ethics*, 26(1), pp. 245 – 255.
- Greenwood, D. and Walker, P. (2000). *Procurement, Contracts and Conditions of Engagement: MSc. lecture material in Law and contract strategy*. University of Northumbria at Newcastle, Available at <http://e-learning.www.unn.ac.uk>, Accessed 24th May, 2006.
- Jacob, O.A. (2010). Procurement Law in Nigeria: Challenge for attainment of its objectives. *University of Botswana Law Journal*, pp. 131-151.
- Jones, T. M., and Wicks, A.C. (1999). Convergent Stakeholder Theory. *Academy of Management Review*, 24(2), pp. 206–221.
- Lim C.S and Zain M.M. (1999). Criteria of Project Success: An explanatory re-examination. *International Journal of Project Management*, 30(4), pp. 243-248.
- Latham, R. (1994). *Constructing the Team: Final Report of Government /Industry review of Procurement and Contractual Arrangements in the UK Construction Industry*. HMSO, London.
- Love, P.E.D, Skidmore, M., and Earl, G. (1998). Selecting a suitable procurement method for building project. *Construction Management and Economics*, 16(2), pp. 221-233.
- Love, P.E.D., Irani, Z., Cheng, E. and Li, H. (2002). A model for supporting inter -organizational relations in the supply chain, *Engineering, Construction and Architectural Management*, Vol. 9 (1), pp. 2-15.
- Mainardes, E. W., Alves, H. and Raposo, M (2011). Stakeholder Theory: Issues to Resolve. *Management Decision*, 49 (2), pp. 226- 252.
- Mason, J. (2002). *Qualitative Researching*. London: Sage Publications Limited.
- Masterman J.W.E. (2002). *An Introduction to Building Procurement Systems*, (2nd edn.), Spon Press, London.
- Mathonsi, M. D. and Thwala, W. D. (2012). Factors influencing the selection of procurement systems in the South African construction industry. *African Journal of Business Management*, 6(10), pp. 3583-3594.
- Nzekwe-Excel, C. (2012). Satisfaction Assessment in the Construction Projects: A Conceptual Framework. *Built Environment Project and Asset Management*, 2(1), pp. 86-102.

- Ofori, G. (2000). Challenges for Construction Industries in Developing Countries. *Proceedings of the Second International Conference of the CIB TG 29*, Gaborone, Botswana, November, pp. 1–11.
- Ogunsanmi, O.E. and Bamisile, A. (1997). Factors Affecting the Selection of Project Procurement Methods. *Builders Magazine*, 12, pp.11-16.
- Omonori, A. and Lawal, A. (2014). Understanding Customer satisfaction in Construction Industry in Nigeria. *Journal of Economics and Sustainable Development*, 5(25), pp. 115-120.
- Parasuraman, A., Zeithaml, V. A. and Berry, L. L. (1985). A Conceptual Model of Service Quality and Its Implications for Future Research. *Journal of Marketing*, 49, pp. 41–50.
- Bureau of Public Procurement (2015). *Public Procurement Act*. Available at www.bpp.gov.ng/?ContentPage&sub_cnt. Accessed on February 23rd, 2015.
- Saunders, M., Thornhill, A and Lewis P. (2003). *Research methods for business students*. 3rd edn., New York: Prentice Hall.
- Strong, Ringer and Taylor (2001). The Rules of Stakeholder Satisfaction. *Journal of Business Ethics*, 32(3), pp. 219 – 230.
- Rwelamila, P.D. (2010), Impact of Procurement on Stakeholder Management. In Chinyio, E. and Olomolaiye, P. (Eds.) *Construction Stakeholder Management*, West Sussex, Wiley Blackwell Publishing, pp. 195-215.
- Rwelamila, P. D., Talukhaba, A. A. and Ngowi, A. B. (1999). Tracing the African project failure syndrome: The significance of ‘ubuntu’. *Engineering, Construction and Architectural Management*, 6 (4), pp. 335-346.
- Watermeyer, R.B. (2011) “A framework for developing construction procurement strategy, *Proceedings of the Institution of Civil Engineers- Management, Procurement and Law*, 165(4), 223-237.
- Williams – Elegbe, S. (2012). A Comparative Analysis of the Nigerian Public Procurement Act against International Best Practice. Accessed on 20 February, 2015; Available online at <http://www.ippa.org/IPPC5/Proceedings/Part3/PAPER3-9.pdf>

FINANCIAL PERFORMANCE OF MULTINATIONAL CONSTRUCTION COMPANIES IN SOUTH AFRICA

Odediran, Sunday Julius; Windapo, Abimbola Olukemi

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, Western Cape, South Africa

Abstract

The paper examines the financial performance of multinational construction companies (MNCC) in South Africa and whether the financial resources of these MNCC are sufficient to meet the demands of the domestic market. The rationale for this examination stems principally from the need for large scale contractors to have enormous resources and capabilities for the execution of construction works in international markets. Although, this has made international markets to be oligopolistic. The research makes use of the Engineering News-Record (ENR) data set as a standard through which the level of revenues and assets of MNCC in South Africa were assessed in order to know whether these financial resources are sufficient for international construction operation. Financial and other relevant data were collected through a qualitative research approach from four MNCC listed on the Johannesburg Stock Exchange (JSE). These data were obtained through an evaluation of the archived data (annual and financial reports); and analysed using content and thematic analysis. The paper establishes that the financial capabilities of MNCC in South Africa are adequate for overseas market operations. This is because their revenues and assets compete favourably with their counterparts from other parts of the world who were ranked among the top 100 by the ENR in 2015. The paper concludes that the construction market in South Africa would tend to be oligopolistic if other African-based construction companies do not build up their financial resources so as to be able to compete in the domestic, cross-border African and International construction markets.

Keywords: Construction companies, Financial performance, International markets, Multinational companies, South Africa

1 Introduction

This paper examines the financial status of MNCC in South Africa. Construction market has become a global market due to the impact of globalization which enables transfer of resources, skills and capabilities mostly from developed to under-developed/developing economies (Ofori, 2000; Ngowi et al., 2005) and vice versa in recent times. Globalization also had made irrelevant national and political boundaries; it has increased economic reliance; and exposed national and societal differences relating to cultures and business issues (Ngowi et al., 2005). However, only large-scale construction companies operate in international markets because international construction projects are often of large scale in scope (Jaring, 2009) and due to the nature and magnitude of risks in the markets when compared to a local market (Gunhan and Arditi, 2005; Loo, *et al.*, 2013). The larger the scale of a project, the more is the demand in term of resources (material and human) commitment in overseas operations.

For a company to succeed in international markets, certain level of resources and capabilities are required to meet the demands that may arise due to the magnitude of uncertainties associated with overseas construction. Capabilities are configurations of routines and resources that allow an organization to achieve its goals (Nelson and Winter, 1982). However, dynamic capabilities reflect a firm's capacity to reconfigure its capabilities to adapt to its environment (Eisenhardt and Martin, 2000; Sapienza, Autio, George and Zahra, 2006). The demand for enormous amount of resources (materials and labour) for overseas markets operation had made international markets to become oligopolistic i.e. few large firms control the major shares in international markets (Messner, 2006; Kenter, 2014). However, there are limited studies that establish the experiences of MNCC on international construction markets within Africa. This paper examines the financial records of MNCC in South Africa with a view to establish whether their financial strength are sufficient to meet the demands of the local construction market using the Engineering News Record (ENR) annual ranking of international contractors as a basis of assessment. The research investigates the level of revenues and assets of MNCC in South Africa and how sufficient these resources are for operation in an international space when benchmarked against global standard.

2 Literature review

This section presents a review that justifies the significance of financial indicators as a measure for successful operation of construction companies in overseas markets and outlines the financial performance of international contractors as established by ENR.

2.1 Financial requirements for international market operation

Construction works could be situated either locally or internationally depending on where clients who own the projects or construction companies who execute the projects reside. Similarly, a company becomes international if it exports its services and resources (materials and human) to other markets outside its home country. According to Forlani et al. (2007), a capability is the ability of the firm to successfully manage its assets and activities in the international environment while Eisenhardt and Martin (2000) describes dynamic capabilities as an organizational strategic routine whereby managers alter their firms' resource base to generate value-creating strategies. Similarly, dynamic capabilities reflect a firm's capacity to reconfigure its capabilities to adapt to its environment (Sapienza et al., 2006). The level of uncertainties associated with overseas markets pose a demand on firms going international to be well equipped with certain measures of capabilities before entry into unknown market terrains (Jaring, 2009).

The measures of resources and capabilities that are essential have been argued in literature. In a study by Gunhan and Arditi (2005) on factors affecting international construction, measures of resources and capabilities required for overseas operation highlighted include track record/performance, specialist expertise/human resources, technical skills, international network/experiences, financial strength (revenues) and equipment (assets). Li et al. (2013) established that resources like know-how, capital, technology, equipment and personnel are as significant for firms to attain success in foreign markets. Similar studies further argued that firms going international without having sufficient number of employees, technological base/assets and adequate revenue base are on a suicidal mission (Majocchi, Bacchiocchi and Mayrhofer, 2005; Suarez-Ortega and Alamo-Vera, 2005; Filatotchev, Liu, Buck and Wright, 2009; Serra, John and Abdou, 2012).

In another view, level of resources and capabilities within firms are trio in nature and these cover financial (revenues & assets), human (technical & managerial employees) and experiential (years of operation) (Evans and Berman 1994). The major argument in international business environment is how best or to what advantage these resources are used

in meeting the demands posed due to level of constraints in overseas markets (Grant, 2008; Ballegoöljen, 2010). Tucker et al (2015) established that financial capacity is a predictor of construction company performance. It becomes obvious that firms cannot have a successful operation in foreign markets without being adequately equipped with required resources and capabilities such as financial, human and experiential. Hence, financial resources such as revenue and assets of MNCC in South Africa were considered in this paper. The following section presents a review of the revenues of the Top 250 international contractors as annually ranked by ENR.

2.2 Revenue of the Top 255 international contractors

Engineering News Record (ENR) is a monthly global publication with a focus on ranking of top international contractors, shares of regional markets and construction services among the top rated international contractors. The ranking is based on the level of revenue that individual firm generates annually from global construction markets out of its total revenue. A review of the 2015 edition of the ENR publication reveals revenues of the top rated international contractors over a decade (2005-2014) (see Table 1) while their total revenue between 2001 and 2004 were obtained from other sources (Reina and Tulacz, 2014; Statista, 2015).

Table 1. International Contractors Revenues from 2001-2014

S/N	Year	Revenues (US\$ Billion)
1	2001	106.5
2	2002	116.5
3	2003	139.8
4	2004	167.5
5	2005	189.4
6	2006	224.4
7	2007	310.3
8	2008	390.0
9	2009	383.8
10	2010	383.7
11	2011	453.0
12	2012	507.5
13	2013	544.0
14	2014	521.5

(Source: Reina and Tulacz, 2014; Statista, 2015)

In addition, the nationalities and revenues of the top 20 international contractors in 2013/2014 was also examined (see Table 2) and the share of the global construction market across the nationalities of the Top 250 international contractors in 2013 according to the ENR records is further presented in Table 3.

Table 2. International Revenues of the Top 20 International Contractors in 2013/2014

S/N	Contractor Name	Nationality	Revenues (US\$ Billion)
1	Group ACS	Spain	44.05
2	Hochtief AG	Germany	34.65
3	Bechtel	United States	23.64
4	Vinci	France	20.29
5	Fluor Corp	United States	16.78
6	Strabag	Australian	15.39
7	Bouygues	France	14.79
8	Skanska	Sweden	14.14
9	CCC	China	13.16
10	Technip	France	12.24
11	Saipem	Italy	12.14
12	Constutoral Norberto Oderechit	Brazil	9.88
13	Hunndae Engineering and Construction	South Korea	8.71
14	Ferrovial	Spain	7.42
15	Samsung Engineering	South Korea	7.13
16	Bilfinger	Germany	6.85
17	Samsung C & T	South Korea	6.31
18	Royal BAM Group	Netherlands	5.94
19	Abemsa	Spain	5.82
20	China State Construction Engineering	China	5.74

(Source: Statista, 2015)

Table 3. Share of International Construction Market across Nationalities of 250 Top International Contractors in 2013

S/N	Contractor Nationality	Number of firms	Revenue (US\$ Million)	Percentage (%)
1	AMERICAN	31	70,955.4	13.0
2	CANADIAN	2	1,112.4	0.2
3	EUROPEAN	58	272,040.6	50.0
	British – 2			
	German – 5			
	French – 5			
	Italian – 16			
	Dutch – 3			
	Spanish – 13			
	Others – 14			
4	AUSTRALIAN	4	10,589.1	1.9
5	JAPANESE	14	22,243.8	4.1
6	CHINESE	62	79,013.0	14.5
7	KOREAN	13	42,415.9	7.8
8	TURKISH	42	20,409.2	3.8
9	BRAZILIAN	4	12,977.4	2.4
10	ALL OTHERS	23	12,084.6	2.2
	ALL FIRMS	250	543,840.4	

(Source: Reina and Tulacz, 2014)

Further assessment of the ENR Records presented in Table 4 highlights the level of revenue being generated by international contractors by region in 2013. Prior to this period, the revenues generated by international contractors outside their home countries in 2006 was estimated at US\$224.43 with a growth rate of 18.5% from US\$184.41 in 2005. In 2009, their earnings were estimated at US\$383.78 billion and the biggest increases in international contracting revenues came from Africa. Notably, their international revenues in central and southern Africa grew by 31.7% to \$29.29 billion in 2009 from \$21.04 billion in 2008. North Africa grew by 30.8% to

US\$27.52 billion in 2009 from US\$21.04 billion in 2008 (Reina and Tulacz, 2010). In 2013, the total revenues of international contractors had grown to US\$543.97 billion with Central/Southern and North Africa representing US\$41.23 billion (7.6%) and US\$21.02 billion (7.2%) respectively (see Table 4) (Reina and Tulacz, 2014). Nevertheless, statistics about other regions such as East and West Africa are excluded. Gaps in infrastructural needs within Africa have received global attention in recent times due to the backlog of physical infrastructure such as power/electricity, roads, water etc. in most of the African states (AfDB, 2011).

Table 4. Revenue of International Contractors in 2013

Region	Revenue (US\$ billion)	Percentage (%)
Europe	111.86	20.6
Middle East	84.13	15.5
Asia and Australia	146.47	26.9
United States	48.41	8.9
South/Central Africa	41.22	7.6
North Africa	21.02	3.9
Latin America	54.12	9.9
Canada	34.20	6.3
Caribbean Islands	2.41	0.4
Other Arctic/Antarctic	0.13	0.0
Total	543.97	

(Source: Reina and Tulacz, 2014)

3 Research Methodology

A review of literature was carried out to establish the financial requirements for international markets operation and the significance of revenue as a major financial requirement for international construction operations. The study from which data discussed in this paper were obtained employed a convergent mixed methods research approach in data collection and analysis. However, the paper presents a part of the qualitative data analysis result. The study was conducted on South African MNCC construction companies, which are registered with the cidb on Grades 8 and 9. The qualitative strand in form of case studies (interview and documents analysis e.g. annual/financial reports) was conducted on MNCC that are listed on the Johannesburg Stock Exchange (JSE). A sample frame of nine MNCC was obtained and all were listed on Grade 9 with some on Grade 8 in the cidb Register of Contractors. These grades of contractors are considered because they are on the uppermost grade of the cidb Contractor Register in South Africa and are capable of operating in the international space. Out of this, a sample size of 4 was selected for investigation, which represents 44.44% of those construction companies listed on JSE. Data reported in this study were obtained through the evaluation of the archived data (annual and financial reports) of MNCC in South Africa, which were mostly obtained from the companies' websites. These data include their grade, region of operation/geographical presence, construction services being exported/areas of specialization, revenue, assets, number of employees, and international experiences/year of establishment/listing. Other data extracted are risks encountered and entry models to African markets. Data obtained were analyzed using NVivo in forms of content and thematic analysis.

4 Findings and Discussion

4.1 Background information of the JSE listed companies in the case study

Table 5 presents the background information about the companies who were selected as the cases in the study. There were 4 cases and each of them registered on grade 9, which means that the cases constituted the large-sized contractors in South Africa. All are registered to

execute large scale infrastructural projects which are mostly general building and civil engineering works. Most of these cases had been established for more than 4 decades and listed on JSE. Similarly, the permanent workforce on the payrolls of most of these cases are more than 10,000 and they operate in African countries, Middle East, Eastern Europe etc. These data show that the cases/JSE listed MNCC investigated are actually large-scale contractors; have adequate experiential and human capitals; are operating in international space and could be described as international contractors.

Table 5. Background information of the cases/JSE listed companies

Type	Grade	Class of work	Year Established	JSE Listed	Current Employees	Regions of operation
A	9	9CE & 9GB	1971(more than 40 years)	2007	>12,000	Africa countries, Middle East, Abu Dhabi & Qatar
B	8, 9	8GB, 9CE & 9GB	1984 (more than 30 years)	nil	>1,000	Southern African Development Community (SADC)
C	9	9CE & 9GB	1974(more than 40 years)	1978	>12,000	Africa countries, Middle East & Eastern Europe
D	8, 9	9CE & 9GB	1970(more than 40 years)	1994	>14,000	SADC, Middle East, Indian Oceans Islands

Key: CE- Civil Engineering; GB- General Building; CEO- Chief Executive Officer
(Source: Authors, 2015)

4.2 Financial resources and capabilities of the cases/JSE listed companies

This paper examines how the cases/JSE listed MNCC in South Africa behaved financially over a period of ten years. The results as presented in Table 6 and Figure 1 show that the revenues of these companies range between 2.57 to 36.039 billion rand. The average revenue for company A over a period of ten (10) years was 7.418 billion rand; and 33.736, 9.630 and 14.165 billion rand for companies B, C and D respectively. These are equivalent to US\$539.065million, US\$2.544billion, US\$726.244million and US\$1.068billion for companies A, B, C and D respectively.

Table 6. Revenues of the cases/JSE-listed companies (2005-2014)

Year	Companies (US\$ Billion Rand)			
	A	B	C	D
2005	-	10694	4939	4765
2006	-	11098	5865	5795
2007	-	17815	7689	8128
2008	2570	27898	8900	10784
2009	6317	32684	12090	14769
2010	7417	31962	11338	15201
2011	8998	30535	9207	14767
2012	8068	35406	9805	17893
2013	9057	34575	11131	23773
2014	9498	36039	15340	25777
Average	7418	33736	9630	14165

1 US Dollar = 13.26 (Accessed October 12, 2015)

This is significant when compared with the total revenue of the top 250 international contractors in 2014 as ranked by ENR (Reina and Tulacz, 2015). In addition, these are higher than the total revenues of most of the contractors ranked on the ENR list. The extract of the revenues of the top 100 international contractors in 2014 is shown in Table 7 and the result shows that the revenues of the cases examined can compete favourably within this group as

ranked by ENR. However, most of the contractors with ranking below 100 on a total rank of 250 international contractors had total revenues less than that of MNCC in South Africa in 2014. However, company B has the strongest financial base followed by companies D, C and A.

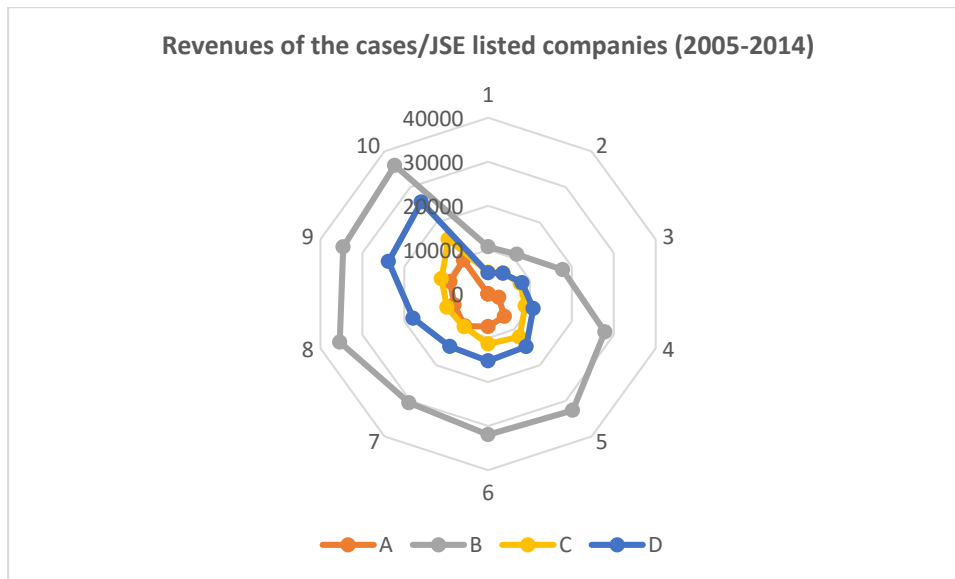


Figure 1. . Revenue of the cases/JSE listed companies (2005-2014)

Table 7. Total revenue of the Top 100 international contractors in 2014

S/N	Ranking	Name	2014 Total revenue (US\$ Billion)	
	2015	2014		
1	62	85	POLIMEKS INSAAT TAAHHUT VE SAN TIC. AS, Istanbul, Turkey	2.2026
2	65	52	ENKA CONSTRUCTION AND INDUSTRY CO. INC, Istanbul, Turkey	2.1389
3	69	66	VAN OORD, Rotterdam, The Netherlands	2.5663
4	74	84	CHINA INT'L WATER & ELCTRIC CORP., Beijing, China	1.5417
5	79	81	JOANNOU & PARASKEVAIDES GROUP OF COS, Guemsey, Channel Island, UK.	1.3801
6	80	78	MAIRE TECHNIMONT, Milan, Italy	1.6137
7	82	83	TAV CONSTRUCTION, Istanbul, Italy	1.4544
8	85	105	THE ARAB CONTRACTORS CO., Cairo, Egypt	2.3670
9	86	93	CGCOC GROUP CO. LTD, Beijing, China	1.1098
10	89	157	CALIK ENERJI SAANAYI VE TICARET AS, Ankara, Turkey	1.0107
11	90	101	TEKFEN CONSTRUCTION & INSTALLATION CO. INC, Istanbul, Turkey	1.3460
12	91	64	SHANGHAI ELECTRIC GROUP CO. LTD, Shanghai, China	1.5360
13	92	107	ANT YAPI CONSTRUCTION, INDUSTRY & TRADE CO. LTD, Istanbul, Turkey	1.0568
14	94	96	CONDOTTE SPA, Rome, Italy	1.5364
15	95	99	ARABIAN CONSTRUCTION CO., Abu Dhabi, U.A.E.	1.0484
16	97	106	BAUER AG, Schrobenhausen, Bavaria, Germany	1.1690
17	99	118	SHANGHAI CONSTRUCTION GROUP, Shanghai, China	0.9095

(Source: Reina and Tulacz, 2015)

The result on the assets of the companies presented in Table 8 and Figure 2 reveal that the assets of the MNCC's studied in South Africa range between 2.291 to 24.532 billion rand. In a period of ten (10) years, the average revenue for company A was 5.555 billion rand, 18.494 for company B and 7.833 and 8.304 billion rand for companies C and D respectively. These are equivalent to US\$418.929million, US\$1.395billion, US\$590.724million and US\$626,244billion for companies A, B, C and D respectively. These are significant assets when compared with their revenues. Company B has the highest asset base followed by D, C and A respectively.

Table 8. Total assets of the cases/JSE listed companies (2005-2014)

Year	Companies (Billion Rands)			
	A	B	C	D
2005	-	8104	2867	2291
2006	-	10385	4904	3008
2007	-	13011	6888	4248
2008	4371	21650	9250	7958
2009	5024	23493	10373	9608
2010	5027	21952	9950	9358
2011	5604	19560	7771	9492
2012	5991	22442	7589	11342
2013	6571	24532	8804	12337
2014	6298	19811	9933	13398
Average	5555	18494	7833	8304

1 US Dollar = 13.26 (Accessed October 12, 2015)

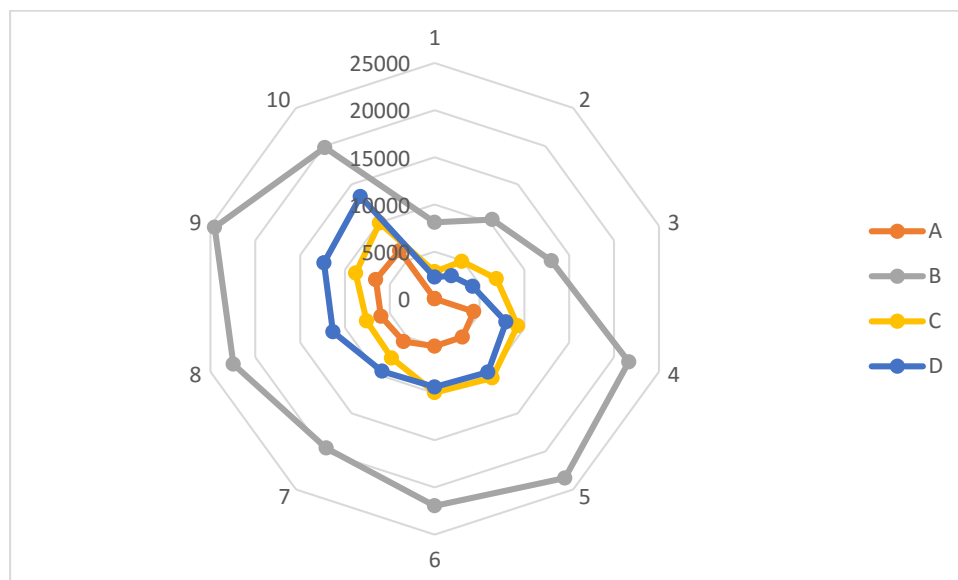


Figure 2. Assets of the cases/JSE listed companies (2005-2014)

From the result of international contractors ranking by ENR in 2015, it was established that there are contractors among the top rated 250 international contractors that has revenue that is as low as US\$101. 9 Million (Reina and Tulacz, 2015). However, the average revenue of MNCC examined in South Africa over a period of 10 years range between US\$7.418 to 33.736 Billion. Within the same period of years under review, the least total revenue among the cases/JSE companies investigated was US\$2.570 Billion with the maximum up to US\$33.736

Billion. These figures reveal that the total revenue of the significant number of international contractors as ranked by ENR are below the revenue of MNCC in South Africa. This therefore supports the argument that the financial performance of MNCC in South Africa are adequate and this place them on leverage to compete globally.

5 Conclusion and Further Research

This paper examines the financial performance of MNCC in South Africa and this was achieved through cases investigation (annual and financial reports) of JSE listed construction companies. A review of extant literature reveals that financial resources and capabilities such as revenues and level of assets are significant for any firms intending to internationalize. It was established in the cases conducted that there are construction companies in South Africa that are multinational because they are of large scale and have adequate financial, experiential and human capitals. It was further revealed through data obtained that the revenue of MNCC in South Africa is adequate when compared with the total revenues of the top 100 international contractors in 2014. The paper concludes that the construction market in South Africa would tend to be oligopolistic if other African-based construction companies do not build up their financial resources so as to be able to compete in the domestic, cross-border African and International construction markets. Further research that aims to employ financial ratios in establishing the level of financial performance of the cases/JSE listed construction companies is proposed.

6 Acknowledgement

The financial assistance of the University of Cape Town through Postgraduate Funding Office, Construction Industry Development Board (cidb) South Africa and Tertiary Education Trust Funds (TETFund), Nigeria towards this research is hereby acknowledged. Opinions expressed or conclusions arrived at, are those of the authors and not necessarily to be attributed to the sponsors.

7 References

- African Development Bank (AfDB) (2011) *African Development Report 2011: Private Sector Development as an Engine of Africa's Economic Development*, AfDB: Tunisia.
- Ballegoöljen A. (2010). Entry mode: attain advantage of entry mode choice. Unpublished Bachelor thesis in organization and strategy, Universiteit van Tilburg.
- Eisenhardt, K. and Martin, J. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, 21, 1105-1121.
- Evans, J R. and Berman, B (1994). *Essentials of Marketing*, Macmillan Publishing Company, NY, p.9.
- Filatotchev, I., Liu, X., Buck, T. and Wright, M. (2009). The export orientation and export performance of high-technology SMEs in emerging markets: The effects of knowledge transfer by returnee entrepreneurs. *Journal of International Business Studies*, 40, 1005–1021.
- Forlani, D., Parthasarathy, M. and Keaveney, S.M. (2007). Managerial risk perceptions of international entry-mode strategies. *International Marketing Review*, 25(3), 292-311.
- Grant, R. (2008). *Contemporary strategy analysis*. Malden: Blackwell.
- Gunhan, S. and Arditi, D. (2005). Factors Affecting International Construction. *Journal of Construction Engineering and Management*, ASCE/March, 273-282
- Jaring, (2009). Factors Affecting International Construction; Challenges and Opportunity of Singaporean based company in going abroad. *With Great Power Comes Great Responsibilities*. Accessed 2014/04/28
- Kenter, P. (2014). *Emerging markets to boom with construction activity*. Daily Commercial News. Construction Market Data Group Inc.

- Li, H, Jin, Z, Li, V, Liu, G. and Skitmore, RM (2013). An entry mode decision-making model for the international expansion of construction enterprises. *Engineering, Construction and Architectural Management*, 20(2), 160-180.
- Loo, S.C., Abdul-Rahman, H. and Wang, C. (2013). Managing External Risks for International Architectural, Engineering, and Construction (AEC) firms operating in Gulf Cooperation Council (GCC) States. *Project Management Journal*, 44(5), 70-88.
- Majocchi, A., Bacchiocchi, E. and Mayrhofer, U. (2005). Firm size, business experience and export intensity in SMEs: A longitudinal approach to complex relationships. *International Business Review*, 14, 719–738.
- Messner, J.I. (2006). Offshoring of Engineering Services in the Construction Industry. NAE *Workshop on the Offshoring of Engineering: Facts, Myths, Unknowns, and Implications*, October 24-25.
- Ngowi, A.B., Pienaar, A., Talukhaba, A. and Mbachu, J. (2005). The Globalization of the Construction Industry – a review. *Building and Environment*, 40, 135-141.
- Nelson, R.R. and Winter, S.G. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap Press of Harvard University Press.
- Ofori, G. (2000). *Globalization and construction Industry development: research opportunities*.
- Reina, P. and Tulacz G. (2010). The Top 225 International Contractors, The Construction Weekly ENR Engineering News-Record, The McGraw-Hill companies.
- Reina, P. and Tulacz G. (2014). The Top 250 International Contractors, The Construction Weekly ENR Engineering News-Record, The McGraw-Hill companies.
- Sapienza, H.J., E. Autio, G. George and Zahra, S.A. (2006). A capabilities perspective on the effects of early internationalization on firm survival and growth. *Academy of Management Review*, 31(4), 914-933.
- Serra, F., Pointon, J. and Abdou, H. (2012). Factors influencing the propensity to export: A study of UK and Portuguese textile firms. *International Business Review*, 21, 210-224.
- Statista (2015). The revenue of the largest construction contractors worldwide in 2013. Available at: www.statista.com/statistics/268311/revenue-of-strabag/accessed/30/04/2015.
- Suarez-Ortega, S. M. and Alamo-Vera, F. R. (2005). SMES' internationalization: firms and managerial factors. *International Journal of Entrepreneurial Behaviour & Research*, 11(4), 258–279.
- Tucker, G. C., Windapo, A. O., & Cattell, K. S. (2015). Exploring the use of financial capacity as a predictor of construction company corporate performance: evidence from South Africa, *Journal of Engineering, Design and Technology*, 13(4) 596-611.

CONCEPTUAL FRAMEWORK OF INFLUENCING FACTORS FOR DESIGN DOCUMENTATION QUALITY

Akampurira Emmanuel; Windapo, Abimbola Olukemi
Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, Western Cape, South Africa

Abstract

Globally and in South Africa, inadequacies in construction design documents negatively impact upon the implementation of engineering construction projects. To date, research studies have focused on the ranking of the factors within the design process that influence the quality of design documentation. However, there has been limited attempt to explore the nature of the interrelationships amongst these factors or to quantitatively illustrate their collective impact on design documentation quality. The overall goal of this on-going research is to develop and test a structural equation model empirically illustrating the nature of interrelationships and collective impact of these factors within the context of the South African construction industry. This paper details the initial stage involving the development of the conceptual model. A comprehensive literature review was undertaken to identify indicators of and factors within the design process that influence the quality of the design documentation. Thirty-seven factors were identified. These were categorised into four latent constructs namely; Industry, Client, Design professional and Design firm related factors. Furthermore, six indicators of design documentation quality were identified. These findings provided the basis for the development of a conceptual model illustrating the hypothesized interrelationship amongst the factors and their impact on quality of design documentation. The conceptual model provides preliminary support and a foundation for further empirical investigation aimed at refining and validating the model within the context of the South African construction industry.

Keywords: Design documentation quality, Design process, Influencing factors, South Africa

1 Introduction

The construction industry is widely recognized as a significant contributor to the social economic development of countries. The provision of physical infrastructure through the implementation of construction projects provides employment opportunities, increases economic productivity and improves the quality of life of citizens (Kessides, 1993; World Bank, 1994).

A typical engineering construction project has three principal role players namely; Project owners or clients, who set the operational criteria for the completed project, provide indication of acceptable costs and delivery period for the construction project; designers who are responsible for producing the design documents that meet the needs of the project owner, and the contractors who are responsible for the execution of the work in accordance to the design documents as prepared by the designer (Oberlender, 1993). Thus in traditionally procured engineering construction projects, there is a separation between design and construction.

Engineering design is described as the process of applying various techniques and scientific principles for the purposes of defining a device, process, or a system in sufficient detail to permit its physical realisation (Reymen, 2001). It is a collective effort combining the skills and knowledge of a number of individuals often working within a design organisation (Emmitt, 2007). A key product of this process is the design documents. These include drawings, project specifications, bills of quantities, construction site specific documentation e.g. geotechnical and topographical surveys. The design documents serve as the link between the design and construction phases of a project and by extension provide the means through which the client's needs are realised. Therefore, it is crucial that the contractor is provided with good quality design documentation containing all information necessary to enable the physical construction activity to be carried out as required, efficiently and without hindrance (Tilley *et al.*, 1999).

The International Standards Organisation (ISO) defines quality as “the degree to which a set of inherent characteristics fulfil requirements.” Degree in this definition means the level to which a product or service satisfies. Characteristics are features of the product that are meant to satisfy. Requirement refers to the needs of the customer (ISO 9000:2005.,). Adopting this definition for the research, with the customer being the contractor; it is then implied that the design documents need to embed certain characteristics and meet the expectations of the project participants in order to be described as being of either poor or good quality. Subsequently, good quality design documentation is characterised by being complete, internally consistent, unambiguous and providing the relevant information on time (Ballard and Koskela, 1998; Emmitt, 2007; Tilley *et al.*, 1999). Tilley *et al.*, (1999) assert that the desired characteristics or attributes associated with the quality of design documentation are: accuracy, completeness, coordination, conformance, clarity, consistency, relevance, standardisation, certainty and representation.

Despite the recognised importance of the construction industry and the associated significance of good quality design documentation, globally inadequacies in construction design documents have been identified as negatively impacting upon the implementation of construction projects (Assaf and Al-Hejji, 2006; Hwang *et al.*, 2009; Josephson *et al.*, 2002; Love and Li, 2000; Love, 2002; Love *et al.*, 2006). Similarly in South Africa, the poor quality of design documentation is identified as a significant contributing factor to project delays (Baloyi and Bekker, 2011; Ramabodu and Verster, 2013); cost overruns (Baloyi and Bekker, 2011; Ramabodu and Verster, 2013; Ramabodu and Verster, 2005) and poor quality (cidb, 2011; Emuze, 2012; Emuze and Smallwood, 2011; Simpeh *et al.*, 2011).

The studies undertaken in South Africa, although not specifically examining the quality of design documentation, provide anecdotal evidence indicating that the quality of design documentation is problematic within the South African construction industry. Notwithstanding this, no known research has been undertaken to specifically investigate the quality of design documentation and the factors that influence it within the context of the South African construction industry. Although lessons could be drawn from studies undertaken in different countries (Abdalaziz, 2009; Love *et al.*, 2006; Minato, 2003; Mohammed, 2007; Philips-Ryder *et al.*, 2013; Samuel, 2011; Slater and Radford, 2012; Tilley *et al.*, 1997; Tilley *et al.*, 1999) and in South Africa (Windapo and Cloete, 2012), a significant number of these studies were undertaken in the context of developed countries in Europe and Asia and focused on identifying and ranking the factors within the design process that influence the quality of design documentation. There has been limited attempt to explore the nature of the interrelationships amongst these factors or to quantitatively illustrate their collective impact on design documentation quality.

The overall goal of this research is to develop and empirically test a structural equation model illustrating the nature of interrelationships and collective impact of these factors on design documentation quality within the context of the South African construction industry. Specifically, this paper details the initial stage involving the development of the conceptual model based on a comprehensive review of pertinent literature.

2 Literature review

In addition to communicating the design intent, design documents play a significant role on construction projects. They influence the attainment of the construction project performance objectives of quality, cost and time, facilitate the identification and allocation of risk amongst the parties (Yong and Mustaffa, 2011; Chua *et al.*, 1999); and in the case of Bills of quantities, these are used for cost estimation and cost control purposes throughout the lifespan of the construction project. (Davis *et al.*, 2009). Results from studies undertaken in a number of countries: Australia (McLennan and Parminter, 2001; Slater and Radford, 2012; Tilley *et al.*, 1997; Tilley *et al.*, 1999), Japan (Minato, 2003), Lithuania (Samofalov and Papinigis, 2010), UK (Samuel, 2011) and Saudi Arabia (Darwish, 2007) indicate a general perception of the existence of poor and a continued decline in the quality of design documentation.

The inadequacies identified in the design documentation include missing information, uncoordinated and conflicting information in the various documents provided, incomplete information, non-applicable details, lack of clarity and failure to use standard details where suitable (Darwish, 2007; Minato, 2003; Samuel, 2011; Tilley *et al.*, 1999).

Whilst there is general agreement on the issue of poor quality of the design documentation, the nature of inadequacies varies from country to country. In the Japanese construction industry, contractors identified incomplete design documentation specifically failure to obtain regulatory approvals prior to construction, as the most significant design document related problem (Minato, 2003). Within the UK construction industry, Samuel (2011), established that, lack of clarity and inaccuracy of project specifications, engineering drawings and bill of quantities negatively impacted upon the efficiency and effectiveness of the tender process. Arain *et al.*, (2004) identified insufficient details on the working drawings as a significant cause of discrepancies during the construction phase of a project.

The above variances suggest that issues related to the quality of design documentation are influenced by the local or context-specific characteristics of the construction industry in question. These unique characteristics need to be taken into consideration in efforts aimed at addressing the quality of design documentation.

2.1 Indicators of quality of design documentation

In a significant number of studies, the quality of design documentation was determined based on the perceived level of incorporation of the design documentation quality attributes (Darwish, 2007; Minato, 2003; Slater and Radford, 2012; Tilley *et al.*, 1999). However, some authors suggest alternative and objective indicators that could be used to gauge the quality of design documentation. These indicators consist of revisions to drawings; Request for Information (RFI); issuance of new engineering drawings; the number of variation orders; submission of Early Warning; and Field technical queries (NEC, 2005; Philips-Ryder *et al.*, 2013; Tilley *et al.*, 2002; Tilley *et al.*, 1997) . The notation Q1-Q6 is used to refer to the above indicators in the conceptual framework.

Philips-Ryder *et al.*, (2013) argue that design documentation issued during the construction phase is often aimed at correcting deficiencies in the original documentation and, therefore, is a good indicator of the quality of the original design document. Similarly, Tilley *et al.*, (1997) reports using information obtained from drawing registers and the RFI process as indicators of

quality of design documentation. The New Engineering Contract suite of documentation specifically refers to the early warning as the means of notification of events that could affect the project costs and timelines. In practise, the Early warning system is often used to provide notification with respect to delay in the provision of information and cost impact of changes to design drawings. This is used in conjunction with the risk register and compensation event clauses (NEC, 2005).

2.2 Review of factors influencing the quality of design documentation

Several studies have reported on the factors that influence the quality of design documentation (Abdalaziz, 2009; Darwish, 2007; Love and Li, 2000; Love *et al.*, 2006; McLennan and Parminter, 2001; Minato, 2003; Philips-Ryder *et al.*, 2013; Slater and Radford, 2012; Tilley *et al.*, 2002; Tilley *et al.*, 1997). A number of the studies have used different approaches to categorise these factors. Tilley *et al.*, (1999) within the context of project delivery, categorised the factors based on the typical construction project phases (that is project initiation phase, design phase, tendering phase and construction phase) while Abdalaziz (2009) grouped the factors into client related factors, tender procedures and designer related factors.

Hales and Gooch (2004) identify a number of factors that influence the engineering design process and as a consequence, the products of the process. These factors are grouped based on the level of influence namely macro-economic, micro-economic and corporate / organisational level factors. Considering the context of this research, the influencing factors for design documentation quality within the design process were categorised under four main latent constructs (see Table 1). Two of the categories, namely Design professional and Client related factors; were based on the major role players on a construction project. The influence of the economic environment and the design organisation was reflected in the choice of the categories of Industry and Design firm related factors respectively.

Table 1 presents a summary of the four latent factors and their respective indicators as identified from the literature review. The frequently reported Client related factors influencing the quality of design documentation are client expectations with respect to time required for design, quality of project brief; and no focal person on client team responsible for design coordination and providing information. Lack of quality control practices and procedures in the generation of design documentation, failure to adopt quality assurance systems and failure to provide relevant training to staff are highlighted with respect to the Design Firm related factors. While low design fees and the use of inexperienced designers were identified as the Industry and Design Professional related factors respectively.

Table 1. Factors influencing the quality of design documentation

INDICATORS/ATTRIBUTE	SOURCE									
	Tilley <i>et al.</i> , (1999)	Love & Li (2000)	Tilley <i>et al.</i> , (2002)	Minato (2003)	Love <i>et al.</i> , (2006)	Darwish (2007)	Abdalaziz (2009)	Slater & Radford	McLeannan & Pariminter (2001)	Phillips-Ryder <i>et al.</i> , (2013)
CLIENT (CR)										
C1	Client expectations with respect to time required for the design.		✓	✓		✓		✓	✓	
C2	The quality of the project brief provided.			✓	✓	✓		✓		
C3	No focal person responsible for design coordination and providing information.			✓		✓	✓		✓	
C4	Clients lack of relevant project experience.			✓		✓			✓	
C5	Changes to client requirements.			✓		✓	✓			
C6	Insufficient and missing information input		✓	✓			✓			
C7	Provision of wrong information by the client.		✓	✓			✓			
C8	Failure to review the design documentation.			✓		✓	✓			
C9	Provision of conflicting information.						✓			
C10	Client expectations with respect to time required for construction.				✓					
C11	Client's insistence to commence construction prior to completion of the detailed design phase.					✓				
DESIGN FIRM (DF)										
D1	Lack of quality control practices and procedures.	✓							✓	✓
D2	Failure to adopt quality assurance systems e.g. ISO 9001.				✓			✓		✓
D3	Failure to provide relevant training to staff.				✓	✓	✓			
D4	Inadequate design review processes.		✓				✓			
D5	Work overload on designers due to low staff levels					✓	✓			
D6	Poor allocation of time with consideration to available workload.					✓	✓			
D7	Lack of relevant software.							✓		
D8	High staff turnover.					✓				
D9	Inadequate supervision of junior design staff.					✓				
INDUSTRY (IR)										
E1	Low design fees.	✓	✓	✓		✓	✓	✓		
E2	Selection of design firms on the basis of lowest price offered.				✓	✓	✓	✓	✓	
E3	Shortage of civil engineering skills				✓	✓		✓	✓	
E4	Low emphasis on professional standards.					✓		✓		
DESIGN PROFESSIONAL (DR)										
F1	The designer is inexperienced.		✓	✓		✓	✓	✓	✓	
F2	Lack of coordination between different design disciplines.	✓		✓	✓	✓	✓	✓		✓
F3	Limited time available for checking and coordinating all design documentation.		✓	✓	✓		✓		✓	
F4	Improper use of design software.				✓	✓		✓		
F5	Reuse of design documents and details from previous projects without effective review.					✓	✓		✓	
F6	Designer's unfamiliarity with construction techniques and materials.				✓		✓	✓		
F7	Heavy work load on the designer.				✓		✓	✓		
F8	Poor communication amongst multi-disciplinary teams.				✓			✓		
F9	Failure to understand the client brief.				✓					
F10	Lack of experience on similar projects.						✓			

3 Research Method

A comprehensive literature review was undertaken to identify factors within the design process that influence the quality of design documentation. In addition indicators of design documentation quality were sought. Google scholar was used as the primary electronic search engine to narrow down the literature consulted to peer-reviewed articles. The keywords used included design documentation, design documentation quality, construction design management, construction design documentation, South Africa construction industry and a combination thereof. After a preliminary perusal of the literature, additional keywords such as contract documentation and Request For Information (RFI) were used to identify other relevant articles for inclusion in the study. The reference lists of these articles were also used to identify additional articles that could contribute to the research. This paper reports specifically on the findings with respect to factors within the design process that influence the quality of design documentation.

4 Proposed Conceptual framework

The findings from the literature review provided the theoretical framework for this study and a basis for the development of a conceptual model. It is hypothesised that factors that are attributed to the industry (IR), the design firm (DF), the client (CR) and design professional (DR) collectively influence the quality of the design documentation. It is further hypothesised industry related factors (IR) may influence the occurrence of client (CR) and design firm (DF) related factors. This influence could, for example, be through legislation regarding selection criteria for engineering design consultants and levels of professional fees paid for their services. Engineering design is often undertaken by designers with complementary skills and experience working within an engineering design firm. It is this set of complimentary skill and experience that the client seeks when appointing a design firm to find a solution to a problem. On this basis, it is assumed that through this interaction, the client related factors influence the occurrence of the design firm related factors. In addition, considering the umbrella role played by the design firm, it is hypothesised that the design firm mediates the influence of industry and client related factors on the design professional.

The proposed model shown in figure 1 explores and it illustrates the hypothesized interrelationship amongst the factors and their impact on quality of design documentation. The latent variables that represent the constructs in the research are shown in the oval symbols while the indicators or measurable attributes of the constructs are shown in the rectangles. The number notation for the indicators is the same as that shown in Table 1. The direction of the arrows represents the hypothesised influence in the model.

The conceptual model provides preliminary support and a foundation for further empirical investigation aimed at quantitatively illustrating the nature of interrelationship and collective impact of these factors on the quality of design documentation within the context of the South African construction industry. In order to examine the nature of the relationship between the design process factors and the quality of design documentation, the research sets out the following hypothesis:

Hypothesis 1: The occurrence of industry related factors (IR) in the design process negatively impacts upon the quality of design documentation.

Hypothesis 2: The occurrence of client related factors (CR) in the design process negatively impacts upon the quality of design documentation.

Hypothesis 3: The occurrence of design firm related factors (DF) in the design process impacts upon the quality of design documentation.

Hypothesis 4: The occurrence of designer related factors (DR) in the design process negatively impacts upon the quality of design documentation.

In order to examine how the design process factors influence one another, the research sets out the following additional hypothesis:

Hypothesis 5: Industry related factors (IR) in the design process interacts with client related factors (CR) to influence the quality of design documentation

Hypothesis 6: Industry related factors (IR) in the design process interacts with design firm related factors (DF) to influence the quality of design documentation.

Hypothesis 7: Client related factors (CR) in the design process interacts with design firm related factors (DF) to influence the quality of design documentation.

Hypothesis 8: Design firm related factors (DF) in the design process interacts with designer related factors (DR) to influence the quality of design documentation.

5 Limitations and Implications for Further Research

The conceptual model presented was developed based on a literature review. It therefore, provides a starting point and a foundation for further empirical investigations and validation within the context of the South African construction industry.

It is recognised that the factors have been identified from studies undertaken in the context of Europe and Asia. As part of the subsequent phases of this research, the relevance and applicability of the identified factors within the context of the South African construction industry will be assessed through an initial round of semi-structured interviews conducted with South African civil engineering consulting professionals. The engineering professionals will be purposefully selected and based in Cape Town. The selection of the professionals for this phase is influenced by the locality of the researcher.

The next stage of the research will involve refining the conceptual model. To achieve this, personal interviews using semi-structured interview protocols will be conducted with twelve experienced engineering consulting personnel identified nationally. Respondents will be requested to verify the existence of the proposed links and influence direction amongst the variables, and include any perceived missing interactions to the conceptual model. The constructs included in the refined model will be tested and validated using information obtained through a nationally administered survey questionnaire to civil engineering consulting professionals. The Structural Equation Modelling technique will be used to establish the statistical significance of the hypothesised relationships between the constructs in the model.

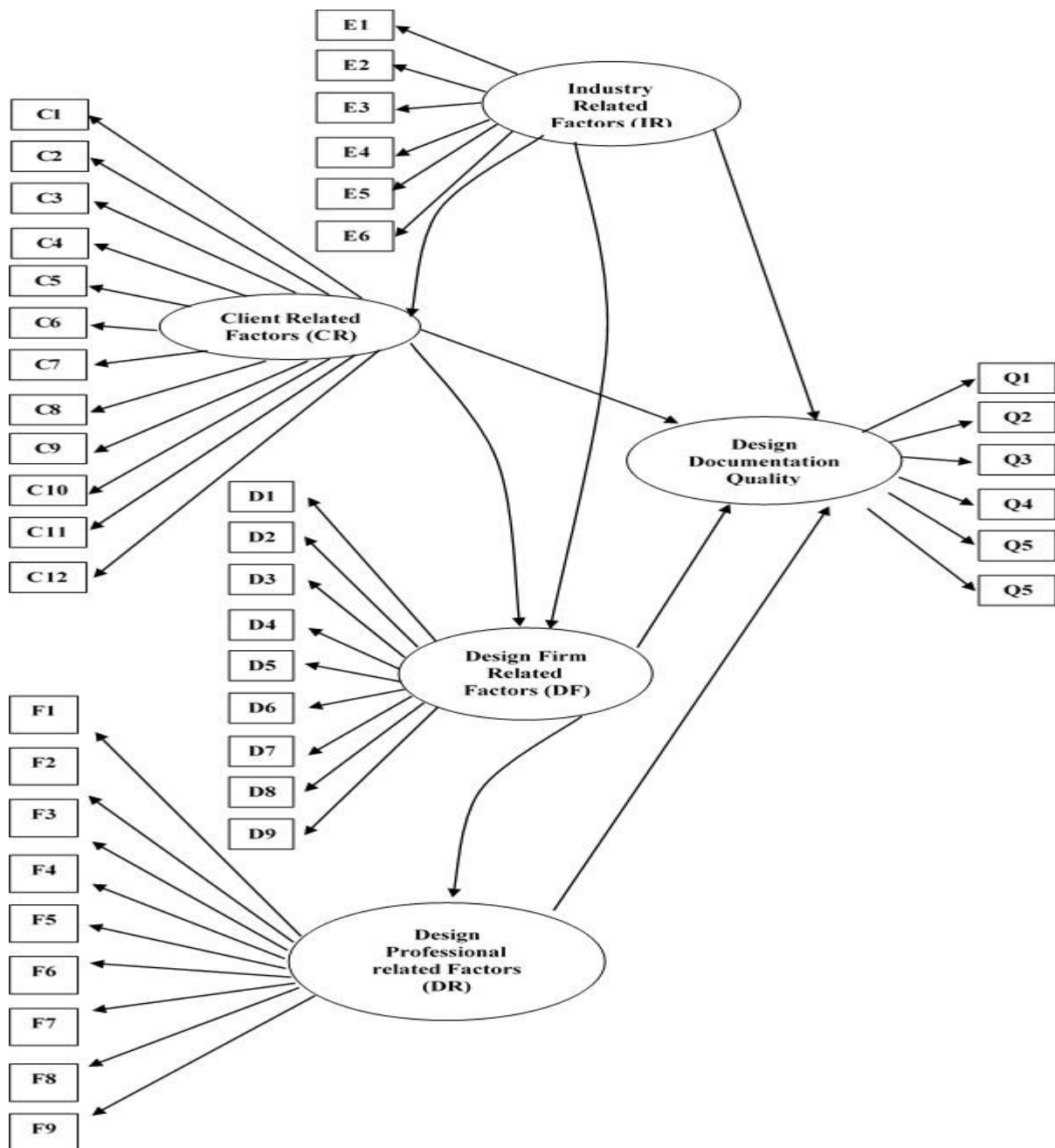


Figure 1. Conceptual model showing hypothesized interrelationship between variables

6 Conclusion

Poor quality of design documentation has been identified as a significant contributor to inefficiencies experienced in the implementation of construction projects, leading to delays, cost overruns and rework. Whilst a number of studies have identified and ranked factors within the design process that influence the quality of design documentation, the nature of interrelationship among the factors, although alluded to remains unexplored.

Following a comprehensive literature review, thirty-seven factors were identified and categorized under four latent constructs namely; Industry, Client, Design professional and Design firm related factors. In addition six objective indicators of design documentation quality were identified. A conceptual model incorporating the categorised factors and illustrating the hypothesized interrelationships among the factors and their impact on design documentation

quality was developed. Using the model as a foundation, a brief discussion is provided on proposed further work aimed at refining and empirically validating the model within the context of the South African construction industry.

7 References

- Abdalaziz, K. (2009). *Factors affecting the quality of design and contractual documents in Gaza Strip* (Masters).
- Assaf, S. A. and Al-Hejji, S. (2006). Causes of delay in large construction projects. *International Journal of Project Management*, 24(4), pp. 349-357.
- Ballard, G. and Koskela, L. (1998). On the agenda of design management research. *The 6th Annual Conference of the International Group for Lean Construction. Guarujá, Sao Paulo, Brazil*, 13-15.
- Baloyi, L. and Bekker, M. (2011). Causes of construction cost and time overruns: The 2010 FIFA World Cup stadia in South Africa. *Acta Structilia*, 18(1), pp. 51-67.
- Chua, D., Kog, Y. and Loh, P. (1999). Critical success factors for different project objectives. *Journal of Construction Engineering and Management*, 125(3), pp. 142-150.
- cidb. (2011). *Construction Quality in South Africa: A Client perspective*. Pretoria, South Africa: Construction Industry Development Board.
- Darwish, M. I. (2007). Factors affecting design and documentation quality in the construction industry.
- Davis, P. R., Love, P. E. and Baccharini, D. (2009). Bills of Quantities: nemesis or nirvana? *Structural Survey*, 27(2), pp. 99-108.
- Emmitt, S. (2007). *Design management for architects* John Wiley & Sons.
- Emuze, F. (2012). *Performance Improvement in South African Construction* (PhD).
- Emuze, F. and Smallwood, J. (2011). Improving project delivery in South African construction. *Procs 27th Annual ARCOM Conference*, 921-930.
- Hales, C. and Gooch, S. (2004). *Managing Engineering Design* (Second ed.) Springer.
- Hwang, B., Thomas, S. R., Haas, C. T. and Caldas, C. H. (2009). Measuring the impact of rework on construction cost performance. *Journal of Construction Engineering and Management*, 135(3), pp. 187-198.
- ISO 9000:2005. *Quality management systems-Fundamentals and vocabulary (ISO 9000:2005)*. International Standards Organisation.
- Josephson, P., Larsson, B. and Li, H. (2002). Illustrative benchmarking rework and rework costs in Swedish construction industry. *Journal of Management in Engineering*, 18(2), pp. 76-83.
- Kessides, C. (1993). *The contributions of infrastructure to economic development: A review of experience and policy implications* World Bank Publications.
- Love, P. E. (2002). Influence of project type and procurement method on rework costs in building construction projects. *Journal of Construction Engineering and Management*, 128(1), pp. 18-29.
- Love, P. E., Edwards, D. J. and Smith, J. (2006). Contract documentation and the incidence of rework in projects. *Architectural Engineering and Design Management*, 1(4), pp. 247-259.
- Love, P. E. and Li, H. (2000). Quantifying the causes and costs of rework in construction. *Construction Management & Economics*, 18(4), pp. 479-490.
- McLennan, A. and Parminter, T. (2001). Declining standards of project documentation quality in the building & construction industry A major challenge for all stakeholders. *Proceedings of Clients Driving Innovation International Conference*,

- Minato, T. (2003). Design documents quality in the Japanese construction industry: factors influencing and impacts on construction process. *International Journal of Project Management*, 21(7), pp. 537-546.
- Mohammed, R. E. (2007). *An exploratory system dynamics model to investigate the relationships between errors that occur in construction documents in Saudi Arabia and their possible causes* (Doctoral Degree).
- NEC. (2005). *NEC 3 Engineering and Construction Contract* (3rd Edition ed.). Glasgow , UK: Bell & Bain Limited.
- Oberlender, G. D. (1993). *Project management for engineering and construction* McGraw-Hill New York.
- Philips-Ryder, M., Zuo, J. and Jin, X. H. (2013). Evaluating Document Quality in Construction Projects–Subcontractors’ Perspective. *International Journal of Construction Management*, 13(3), pp. 77-94.
- Ramabodu, M. S. and Verster, J. J. (2013). Factors that influence cost overruns in South African public sector mega–projects. *International Journal of Project Organisation and Management*, 5(1), pp. 48-56.
- Ramabodu, M. S. and Verster, J. J. P. (2005). Factors Contributing to Cost Overruns of Construction Projects. . *Proceeding of ASOCSA 5th Built Environment Conference*,
- Reymen, I. (2001). *Improving design processes through structured reflection: A domain-independent approach*. Unpublished manuscript.
- Samofalov, M. and Papinigis, V. (2010). Quality problems of Lithuanian civil engineering design documentation. *The 10th International Conference “Modern Building Materials, Structures and Techniques” : Selected Papers Vol 2*, 768-777.
- Samuel, L. (2011). Quality of tender documents: case studies from the UK. *Construction Management and Economics*, 29(3), pp. 275-286.
- Simpeh, E. K., Ndiokubwayo, R. and Love, P. E. (2011). Field diagnosis of causes and effects of rework in higher education residential facilities. *Journal of Construction*, 4(1), pp. 17-24.
- Slater, R. and Radford, A. (2012). Perceptions in the Australian Building Industry of Deficiencies in Architects' Design Documentation and the Effects on Project Procurement. *Australasian Journal of Construction Economics and Building*, 8(1), pp. 23-33.
- Tilley, P., McFallan, S. L. and Sinclair, R. G. (2002). Improving design and documentation quality. *Cib Report* , pp. 361-380.
- Tilley, P., Mcfillan, S. L. and Tucker, S. (1999). Design and documentation quality and its impact on the construction process.
- Tilley, P., Wyatt, A. and Mohamed, S. (1997). Indicators of design and documentation deficiency. *Proceedings of the Fifth Annual Conference of the International Group for Lean Construction*, 137-148.
- Windapo, A. and Cloete, A. (2012). A Study of Briefing Practices and its Effect on the Quality of Brief Documents and Client/End-User Satisfaction in Constructed Health Care Facilities. *Proceedings of the Joint CIB International Symposium of W055, W065 and W089, W118, TG76, TG78, TG81 and TG84 International Conference on Construction Management Research: Management of Construction – Research to Practice*,
- World Bank. (1994). *World Development Report 1994:Infrastructure for Development* . (). Washington DC: World Bank.
- Yong, Y. C. and Mustaffa, N. E. (2011). Clients, Consultants and Contractors' perception of critical success factors for construction projects in Malaysia. *Procs 27th Annual ARCOM Conference*, 735 735 - 744.

THE ROLE OF PUBLIC PRIVATE PARTNERSHIPS IN THE PROVISION OF INFRASTRUCTURE PROJECTS

Bwanali, Salim; Rwelamila, Pantaleo D.

Graduate School of Business Leadership, University of South Africa (UNISA), Midrand, South Africa

Abstract

It is estimated that Africa needs \$93 billion annually until 2020 in order to bridge its infrastructure deficit. It is through significant investment in infrastructure development that economic growth and poverty alleviation can be enhanced. However central to all construction projects is an effective and sustainable procurement system. There is a notable shift by some African governments to turn to the private sector to design, build, finance and operate infrastructure facilities previously provided by the public sector in the form of Public Private Partnerships (PPP's). As an innovative financing model, PPPs present an opportunity to governments to improve service delivery. It is therefore necessary to access private capital for the provision, delivery and procurement of such public infrastructure. Accordingly, this paper focuses on assessing international best practices as to how some developing nations tap into the resources of the private sector in implementing their infrastructure projects. The findings of this paper reveal common challenges associated with PPP notably lack of political acceptability of PPPs, lack of clear government policy statement on PPPs, weak capacity of the public sector, in appropriate enabling legal and institutional environment among others. Key lessons learned are that PPPs should be designed with a long term approach, PPPs are a long term relationship between the public and private sectors and lastly the project development process should not be rushed unnecessarily. The study is a result of critical review, synthesis and contextualization of relevant academic literature, conference and journal publications. A thorough document review method was employed to assess how some developing countries have institutionalized PPP as part of their development strategy. The paper will be of significant value to senior government officials in that understanding the concept and dynamics of PPP will result in accelerated and effective service delivery.

Keywords: Infrastructure development, Innovative financing model, Public Private Partnerships, risk allocation, Value for Money

1 Introduction

The purpose of this paper is to assess international best practices on how some developing nations tap into the resources of the private sector in implementing their infrastructure projects. The paper reviews recent trends on Public Private Partnerships (PPPs) as a financing and procurement vehicle mainly in the construction projects on the African continent. The study employed exploratory study using document review method of the review protocol designed for the author's dissertation study. The organization of the study is compiled into five parts. The first part discusses the link between infrastructure development and economic growth as well as the status of infrastructure development in Africa, the second one focuses on PPPs as an innovative finance model, the third one outlines the research methodology employed by the

study, the fourth part presents the findings of the study. Finally a conclusion summarizes key lessons learned from the experiences of developing countries that have implemented PPP as an attractive alternative for procuring public service infrastructure.

1.1 The link between infrastructure development and economic growth

The basic gap in African infrastructure development is considered a severe handicap to growth and poverty alleviation. At the micro-level, it is recognized that an investment in infrastructure boosts private sector activities by lowering the cost of production and opening new markets, thereby presenting new production prospects and trade. It is therefore critical that Africa should invest in infrastructure development (Bwanali, 2015). The African Union Commission and Nepad Agency (2011) state that the link between the economy and infrastructure is clearly critical to stimulating inclusive growth and sustainable development. In fact, high cost of energy, transport, and internet access is a major economic growth deflator and is partly linked with Africa's sustained economic marginalization. This has forced governments to upscale infrastructure for Africa to become more competitive in the global marketplace. Increased investments in roads reduce transport costs while ports and other logistics infrastructure lessen the cost associated with trade, all of which improve the competitiveness of firms. Infrastructure development can contribute to growth and development through several channels such as decreasing trade transaction costs, increasing the durability of capital goods, fostering higher trade and investment, escalating demand and supply divergence and achieving economies of scale and scope (United Nations Conference on Trade and Development, 2013). According to Ondiege, Moyo & Chouchane (2013), Africa needs huge financial investments and support to narrow the region's infrastructure gap and set itself on par with the rest of the developing world. African countries must therefore undertake infrastructure sector reforms and innovation to generate more resources for the sector, because the traditional sources of finance will not be sufficient.

Bhattacharya, Romani and Stern (2012) concur that many emerging economies and most low income countries require a significant injection in infrastructure investment to ease growth limitations, respond to urbanization pressures and meet their critical goals for development, inclusive growth, and sustainability. Strategic infrastructure, in the form of energy, roads and ports needs to be built to spur economic growth. According to Bhattacharya *et al.* (2012), the magnitude of the required infrastructure increase is much greater now than it has previously been due to two reasons. Firstly, as global trade is playing an increasingly important role in countries' economic development, so too must infrastructure. This includes traditional transport infrastructure such as roads, railways and ports, but also information technology infrastructure such as broadband networks that enable better integration of supply chains and international trade in services (e.g., in outsourcing services). As emerging countries develop their service and manufacturing sectors, the intensity and excellence of infrastructure becomes critical in order to exploit network externalities. Secondly, the fast pace of urbanization has a greater sustainable infrastructure need than before. Between 2010 and 2030 the global population will have increased by almost 2 billion, from 6.1 to 8.1 billion. Most of this growth is expected to be in the developing world, and nearly all of this will be in urban settlements that are under-developed. Responding to these urbanization pressures will require a massive injection in infrastructure investment, conclude Bhattacharya *et al* (2012). This view is shared by Ernst & Young (2011) who state that by 2050, the world's population is expected to have grown by 2.3 billion people, ultimately reaching 9.1 billion. Therefore there is a need for impactful and sustainable investment in infrastructure that will support the growing African population (Bwanali, 2015).

1.2 The status of infrastructure development in Africa

Africa has enormous infrastructure shortage and it lags behind other developing regions, mostly in the area of energy and transportation but also in Information and Communications Technology (ICTs). In fact only 30% of Africa's population is estimated to have access to electricity, compared to almost 70% to 90% in other developed regions (Ondiege *et al* 2013). In addition, access to roads in Africa is limited to just about 34% of the population, compared with 50% in other parts of the developing world. Although there has been significant progress in rolling out ICTs, largely due to the tremendous increase in mobile connections over the last 10 years, Africa started from a very low base and its internet penetration rate is only about 6%, compared with an average of 40% in the developing world (Ondiege *et al* 2013). Thus, Africa needs to invest a lot in its infrastructure capacity in order to be as competitive as other emerging blocs namely Asia and South America. Landlocked countries in Africa face particular challenges due to the lack of multimodal infrastructure. The continent's 15 landlocked countries are constrained in transporting their goods to markets and in bringing in imports because of the lack multimodal infrastructure that can accommodate their particular requirements. The role of a network of infrastructure that links producers to markets through an interlinked platform that includes feeder roads, national roads, airports, and ports in connecting markets, particularly in landlocked countries, cannot be overemphasized (Ondiege *et al* 2013).

It is widely acknowledged that Africa needs huge financial investments to narrow the existing infrastructure gap in order to be on par with the rest of the developing world. The Programme for Infrastructure Development in Africa (PIDA) states that Africa will have to invest up to US\$ 93 billion annually until 2020 for both capital investment and maintenance projects. Taking into account the substantial amount involved, this requires innovative sources of funding for sustainable infrastructure development and investment (Ondiege *et al* 2013). Over US\$800 billion is invested in infrastructure in developing countries every year. However the needs are estimated to be more than twice that amount, with the infrastructure financing gap estimated to amount to about US\$57 trillion until 2030. Funding the infrastructure gap is thus a major challenge (Bilal, 2013).

This is where investment in infrastructure development through Public Private Partnerships (PPP) as an alternative to the conventional procurement of infrastructure comes in. Before discussing the PPP concept, it is important to first analyse the current situation of the traditional infrastructure investment and its associated challenges and then discuss why the PPP has the potential to become the game-changer for Africa's economic growth and development. The next section discusses generic constraints on project finance.

1.3 Key constraints on project finance

Three related sets of factors limit Africa's potential to tap into both foreign and local currency markets for the purposes of raising private finance for infrastructure, especially long term debt (Sheppard, Stephan & Geeta 2006). Firstly most of the African countries have low or non-existent sovereign credit ratings. In all other developing regions the share would be more than two-thirds of regional GNI, and in East Asia and Pacific, close to 100% (Sheppard *et al* 2006). Secondly, most local financial markets on the African continent have limited capacity to finance infrastructure projects. In fact only South Africa has domestic banks and a local capital market with capacity to provide local currency sufficient for financing infrastructure projects on suitable terms and conditions. In almost all other African countries, local long term financing has been limited and infrastructure projects have had to require sizable credit enhancement (for example, through guarantees), provided mostly by official agencies, to attract local currency debt (Sheppard *et al* 2006). Lastly, infrastructure projects naturally raise the exposure of investments. In comparison to projects in other sectors, those in infrastructure

usually have longer payback and built – out periods and have the tendency to be more vulnerable to political and regulatory interference. This obviously increases the inherent regulatory risk such investments may be facing (Sheppard *et al* 2006). Therefore for Africa to be in a position to raise the required finance for its much needed infrastructure there is a need to improve its sovereign credit ratings, the local financial markets must have capacity to finance infrastructure and Africa must manage the specific risks associated with infrastructure investments (Bwanali, 2015). The next section discusses innovative finance solutions.

1.4 Innovative finance: Instruments to finance infrastructure

Infrastructure development in the emerging economies, especially sub - Saharan Africa, where it is needed most has been very limited. Financing has been a major constraint since most of the current investment in infrastructure comes from the public sector. It is estimated that growth in Africa can be enhanced on average by about 2% per annum only if the existing infrastructure deficit is closed (Boston Consulting Group, 2013). The Boston Consulting Group (2013) further states that whereas the demand for infrastructure is growing, public infrastructure finance has become more difficult to source. Public budgets are strained due to the global financial crisis and, more recently, the Eurozone sovereign debt crisis and the budgets of major donors that have customarily supported aid flows to Africa are under extreme pressure, effectively making ODA increasingly uncertain and likely to decline in the long run. Since the crisis of 2008, it has become exceedingly difficult for banks to lend (e.g. as a result of the Third Basel Accord) and the application of risk mitigation tools (e.g. collateralized debt obligations) has been curtailed, concludes (Boston Consulting Group, 2013).

It becomes imperative that African governments must find innovative ways to fund infrastructure development projects. This can be done by improvising relevant innovative financing models which will not only moderate the impact of these diminishing financial flows, but also to find alternative methods to secure new role players who will push up the level of financing of infrastructure projects (Bwanali, 2015). Innovative financing for development is defined by the World Bank as “those that depart from traditional approaches to mobilizing development finance”, that is, through budget outlays from conventional sovereign donors or bonds issued by multilateral and national development banks solely to achieve funding objectives (UNDP, 2012). One such innovative financing model for infrastructure development is the concept of Public Private Partnerships (PPPs). The next section discusses PPPs as an innovative finance model.

2 Public Private Partnerships as an Innovative Finance Model

Participation of the private sector in public service delivery is not a new concept. Over the last 15 to 20 years, a growing market for public-private partnerships has developed globally. Particularly in industrialized countries, the private sector had for many decades serviced public needs through a range of construction, maintenance and management contracts (Rwelamila & Snijder, 2008). It appears that there is no universally agreed definition of PPP. This paper will adopt National Treasury of South Africa definition which defines PPP as a commercial transaction between an institution and a private party in terms of which the private party – (a) performs an institutional function on behalf of the institution; and/or (b) acquires the use of state property for its own commercial purposes; and (c) assumes substantial financial, technical and operational risks in connection with the performance of the institutional function and/or use of state property; and (d) receives a benefit for performing the institutional function or from utilizing the state property.

What is unique about PPPs in comparison to other models of private participation in infrastructure is the element of risk sharing. This means that in the event that the contract fails, both government and parties will suffer financially. The US Department of Treasury (2015)

states that PPPs bring private sector capital and management expertise to the challenges of modernizing and more efficiently managing assets. Under a PPP, a government contracts with a private firm to design, finance, construct, operate and maintain (or any subset of those roles) an infrastructure asset on behalf of the public sector. The next section discusses benefits of PPPs.

2.1 Benefits of PPPs

PPP's have become a global phenomenon because of the three main types of benefits they offer namely: the capacity to develop new infrastructure services despite short term fiscal constraints; improved service quality and innovation through use of private sector proficiency and performance incentives and lastly value for money realized through efficiencies in procurement, construction and operation. Each benefit is discussed below.

2.1.1 Accelerated infrastructure development

According to the Commonwealth Secretariat (2010), many governments around the world are constrained in terms of how much they can borrow to invest in infrastructure projects. This is especially true for greenfields developments, such as a new power station or major toll road, which typically involve hundreds of millions of dollars of upfront capital expenditure. The problem is most acute in poorer countries, where infrastructure needs are large relative to the size of economies and where fiscal capacity is often severely limited, with many competing demands for scarce resources. Therefore in order to reverse years of underinvestment in infrastructure development in Africa requires high level political will, broader social consensus and dynamic rethink of how African states can fund and manage infrastructure investments. Some African governments have entered into PPPs to provide and manage infrastructure that has traditionally been provided by the public sector. PPPs bring private sector capital and management expertise which are not available in the public sector.

2.1.2 Improved service quality

PPPs have the potential to bring enhanced innovation and augmented service quality largely due to specialist skills brought in by the private sector. This is possible due to the commercial incentive mechanisms that are put in place to deliver improved performance over the life cycle of the contract (Commonwealth Secretariat, 2010).

2.1.3 Value for Money

The growing element in decisions about PPPs is the cost-benefit factor, referred to as value-for-money (VfM). The underlying argument is that the involvement of the private sector in delivering public services must be a better alternative to the public sector providing the same service through its line departments and bureaucratic administrations. PPPs allow governments to introduce private sector capital into a project and also harness private sector management and technical expertise. When a PPP transfers risks to the private sector that it can manage more cost effectively, it can benefit taxpayers by lowering long term project costs, improving the quality of services or both. According to the Commonwealth Secretariat (2010), PPPs allow governments to transfer certain types of risks of infrastructure projects to the private sector. This can bring VfM because in theory the private sector brings specialist expertise and a commercial approach that brings down project costs over the whole life of the contract. In addition, there is increased certainty to taxpayers about the total cost of infrastructure projects because risks of cost overruns are either reduced or passed on to private investors.

Allocation of risk between private and public sectors is a complex area for PPPs due to the unpredictable nature of project risk (Economist Intelligence Unit Limited, 2015). It follows therefore that if the PPP is properly designed at the outset, these efficiency gains are passed on

to the end user. The next section provides a detailed discussion on the types of risks and their allocation.

2.2 Types of risks associated with PPP

Transfer of risk is an element closely linked to the VfM consideration based on the cost associated with service non-delivery and delays in design, construction, and implementation of projects as well as the private sector imperative of business efficiency. Operational efficiency drives the private sector's involvement, especially where contracts values and service fees have been predetermined in legal contracts. Without adequate transfer of risk, the required level of efficiency will not be achieved by the private sector party, which will in turn obscure the value derived from the partnership.

Risks in PPP arise due to uncertainty regarding the occurrence of certain events and their consequent impact on the project. Given the long nature of the contract, there is a possibility of a number of different events occurring such as changes in government policy and decline in demand for the infrastructure service (Commonwealth Secretariat, 2010). Therefore it is critical that there is an appropriate allocation of risks to the party that is most able to mitigate such risks should they occur. The typical risks associated with PPP framework are market risks, development/planning risks, project risks, political risks, regulatory risks and financial risks. These risks are discussed below:

- **Market risks** – these refer to risks that arise due to uncertainties about the market demand for the infrastructure service. These include, for example, volume risks - which relate to uncertainties arising from the number of users and their frequency and intensity of use of the infrastructure service – and price risks, which arise due to uncertainties in the tariff that can be charged for the use of the infrastructure service (Commonwealth Secretariat, 2010). Thus market risks are closely linked to the users' appetite and ability to pay for the services.
- **Development/planning risks** – these are risks arising from planning or preparing projects for private sector participation. Governments or the private sector may invest substantial amounts to develop a project (through payment for several scoping, feasibility and structuring studies), but bear the risk of the project being infeasible (Commonwealth Secretariat, 2010).
- **Project risks** – project risks relate to uncertainties in relation to project construction, completion and operation (i.e. activities post award of contract and which occur while implementing the PPP project) and financing, can be split into start up risks, such as capital cost overrun, completion delays and ongoing risks such as operating performance, operating costs and lifecycle costs (Commonwealth Secretariat, 2010).
- **Political risks** – these are risks that arise from wars, civil disturbances, terrorism etc., and include currency transfer restrictions, expropriation, war and breach of contract. Political risks are more serious in certain regions of the world than in others (Commonwealth Secretariat, 2010).
- **Regulatory risks** – these risks arise from the lack of a suitably developed regulatory system which, for example, ensures regulatory independence from the government, regulations for the participation of the private sector in infrastructure or appropriate periodic review of tariffs can cause considerable uncertainties for lenders and investors in any infrastructure sector (Commonwealth Secretariat, 2010).
- **Financial risks** – infrastructure projects are impacted by financial risks exchange rate appreciation/depreciation and changes in interest rates, which can have a substantial impact on costs and revenues. The ability to hedge financial risks depends on the level

of development of capital markets and/or access to specialist hedging facilities (Commonwealth Secretariat, 2010).

The Commonwealth Secretariat (2010) further states that key to the design of a PPP is the allocation of these risks between the public and private sectors so as to ensure that the PPP delivers VfM. The essential principle for risk allocation in a PPP is to accord the risk to the party who can best manage it. The next section discusses research methods.

3 Research Method

This paper employed exploratory study using document review method of the review protocol designed for the author's dissertation study. This paper is therefore premised on extensive literature study which is based on several reports carried out by various international organizations and researchers to identify current global trends and practices with respect to PPPs. For lack of space and brevity all the details of research methodology are not provided but could be found elsewhere in Bwanali (2015). Therefore the findings in the following section are deduced from relevant literature, government policy documents and articles published in scientific journals.

4 Findings and Discussions

Based on literature reviewed, this paper has identified common challenges associated with PPPs. These challenges together with possible remedial measures are presented below:

4.1 Challenges with PPPs and possible remedial measures

PPP's have some inherent challenges especially in the developing countries and this could be the major reason why there has been little or no progress in implementing PPP projects in most African countries. The Commonwealth Secretariat (2010) identifies such challenges/constraints as lack of political acceptability of PPPs; lack of clear policy statement; weak capacity of the public sector; an inappropriate enabling environment in terms of legal, regulatory and institutional frameworks; the high costs and risks of project development facing the private sector; absence of long term debt; inability of users to afford service fees and the small size of the economy/sector. These challenges impact both the government and the private sector thereby affecting the development and implementation of effective PPPs. The challenges are discussed below.

- **Lack of political acceptability of PPPs** – as discussed earlier, traditionally the provision of social infrastructure for service delivery has been the responsibility of government. Therefore it becomes politically sensitive to involve the private sector in the provision of core infrastructure. The key reasons for such resistance include the perception that tariff might be higher as the private sector is profit oriented, possibility for mass job losses in order to contain overheads and the fear of privatization. The creation of dedicated PPP units, putting in place a mechanism of strong political support along with high level political champion could manage the political resistance. The Labour Movement in South Africa has been at the forefront of protesting key PPP projects such as e-toll in Gauteng as well as planned projects in Cape Town.
- **Lack of clear policy statement** – the success of a PPP programme requires formal support in terms of clear policy statement on the government's strategy for the development of infrastructure PPPs. The lack of a clear policy statement will imply uncertainty and ambiguity, and projects may therefore not get off the ground. Governments need to develop explicit PPP policies and include the use of PPPs in their planning documents (Commonwealth Secretariat, 2010). In South Africa, National Treasury has developed a framework document on PPP and managed through the

Public Finance Management Act (PFMA). In addition, the National Development Plan 2030 has identified public infrastructure development through PPPs, amongst other finance instruments, as one of its top 10 critical actions.

- **Weak capacity of the public sector** – lack of appropriate skills and experience in infrastructure PPPs can lead to delays, inefficiencies and sometimes the failure of infrastructure projects. Poor project development skills in the public sector can lead to the preparation of ‘unbankable’ projects, a common issue to many countries, where the project design and structure is unattractive to private investors. Moreover, weak capacity in the public sector reduces government’s ability to negotiate and communicate effectively with private companies (Commonwealth Secretariat, 2010). As a way of capacitating the public sector on PPPs, some countries have established PPP units that provide governments with expert advice and support on infrastructure PPPs. According to the Economist Intelligence Unit Limited (2015) only 12 African countries have developed central PPP units and their functionality varies from established bodies (South Africa) through to newer start-ups (Uganda and Tanzania). Central PPP units bring advantages such as better coordination, increased efficiency and a clustering of relevant skills in a single place.
- **An inappropriate enabling environment in terms of legal, regulatory and institutional frameworks** – private sector participation requires an enabling legal, regulatory and institutional framework that will guide and support transactions. Many countries do not have legislation to regulate infrastructure PPPs or a regulator that monitors performance and ensures compliance (Commonwealth Secretariat, 2010). In South Africa, Treasury Regulation 16 on PPPs which is issued in terms of the PFMA 2004 is a vital legislation for PPPs which articulates the procedure, approvals and management of PPP transactions. According to the Economist Intelligence Unit Limited (2015) despite good progress, PPP laws often are stronger on paper than in practice. Nigeria and Zambia for instance, have strong legislation pertaining to issues like bidding transparency and dispute resolution, but these are not always effective in practice.
- **The high costs and risks of project development facing the private sector** – early stage development involves a significant investment of resources that are only recoverable if the project is ultimately successful. In addition, in many developing countries, the private sector is at an early stage of development and lacks the knowledge to develop, prepare and structure projects. As a result, infrastructure projects are not fully defined or, if they are, they may be developed to such low standard that competent private sponsors or investors will not be interested (Commonwealth Secretariat, 2010). One way of addressing this challenge is by establishing a fund for project development. According to the Commonwealth Secretariat (2010), India has set up the India Project Development Fund with the objective of structuring and developing bankable projects that can be offered to the private sector on a PPP basis. The Development Bank of Southern Africa which is based in South Africa plays a similar role.
- **Absence of long term debt** – a 20 year life cycle for an infrastructure project implies a considerable time lag between the raising of finance and the ability to pay back through project generated revenues. In most developing countries, it is not possible to raise finance of sufficiently long tenure for infrastructure development. This not only constrains the development of infrastructure due to increased uncertainty, but also makes the infrastructure service more expensive in the short term because of the front-end loaded prices and other factors (Commonwealth Secretariat, 2010). As a counter measure, some governments such as Bangladesh and India have set up project financing

facilities aimed at crowd-in private sector finance by taking up greater risks in the project. The Government of Bangladesh has set up the Infrastructure Development Company Limited (IDCOL) and the Government of India has set up the India Infrastructure Finance Company Limited (Commonwealth Secretariat, 2010). These are the type of project financing facilities that African governments should establish to help crowd-in private sector finance.

- **Inability of users to afford service fees** – perceived lack of ability and willingness to pay for infrastructure services is a key challenge in most developing countries. According to the Commonwealth Secretariat (2010), it is often believed that large numbers of people on lower incomes will be unable to afford full cost-recovery tariffs for electricity or water, especially if the tariff level reflects the high costs of building greenfield infrastructure. In addition, many people may be perceived as being unwilling to pay for essential infrastructure services for political or social reasons such as the e-toll system in South Africa. In instances where it is impractical to levy user charges to recover costs, governments will have to find alternative sources of funds in the form of subsidies.
- **The small size of the economy/sector** – the size of the economy or infrastructure sector is also an important constraining factor limiting the development of PPPs for the delivery of infrastructure services. Small size implies lack of economies of scale in project development, as well as a project size which is below the minimum that is efficient. While size is a constraint for public provision of infrastructure services as well, this is particularly so for PPPs, as a small scale project may be ‘unbankable’ (Commonwealth Secretariat, 2010). One way of improving economies of scale is by initiative regional projects which will result in pooling of resources. A good example within the African context is the Inga hydropower plant to be developed in the Democratic Republic Congo, which is said to have the potential of illuminating the entire African continent, would not be economically viable as an investment by a single country when other countries in the region can benefit from such an investment. The next section looks at the emerging best practices on PPPs and key lessons that can be used by other African government when developing PPPs.

4.2 Emerging best practices on PPPs and key lessons learned

Based on various academic literatures, successful PPPs projects have the potential to deliver significant benefits in terms of increased quantity and quality of infrastructure services at lower overall cost for both end users and taxpayers only if appropriate incentives are in place for the private partner to deliver efficiently. However when PPPs fail, costs can be high which would result in long and exorbitant legal disputes. This would also result in wastage of public funds resulting in a drop in spending on other important infrastructure services. Ultimately this results in poor service delivery. In order to avoid PPPs failure, it is advisable to take a long term view in managing PPPs. According to the Commonwealth Secretariat (2010) many of the key lessons on PPPs are therefore related to the need to take a long term view when designing and implementing a PPP programme. This paper has synthesized three main sets of lessons emanating from the literature study undertaken by the authors and these are discussed below.

5 Conclusion and Key Lessons

This paper has highlighted some opportunities, risks, challenges that some countries have encountered in the implementation of PPPs for infrastructure development. In order to ensure that other African governments can learn from these experiences, the following key lessons are presented:

5.1 Lesson 1: Design PPPs with long term approach together with VfM considerations

As stated earlier, PPPs allow governments to introduce private sector capital into a project and also harness private sector management and technical expertise. The ability to raise funds for infrastructure projects is attractive to governments as they can avoid short term budgetary constraints by spreading up-front project costs over the lifespan of the project. However African governments must avoid the pitfall of viewing PPPs only as a mechanism of raising the much needed and scarce capital. The Commonwealth Secretariat (2010) states that the success of a PPP programme should be assessed against quantity, quality and cost of infrastructure services provided to the public over the long term. Key to ensuring long run sustainability and value for money of PPPs are the following: robust feasibility analysis; proper due diligence in selecting a strong private sector sponsor and good project and contract design.

5.1.1 Robust feasibility analysis

In the early years of modern PPP programmes in Europe and America, a common mistake was for government and project sponsors to overestimate future revenues on PPP contracts. Nowadays there is more awareness of the importance of robust feasibility analysis which incorporates various scenarios about key revenue and cost drivers. In emerging markets, there is often the challenge of a lack of data to inform a feasibility analysis (Commonwealth Secretariat, 2010). For example, there is no tangible evidence on the number of potential end users of a required service which impacts the potential tariffs or user charges to be levied. This results in unreliable feasibility analysis to determine whether the project will be economically viable.

5.1.2 Proper due diligence in selecting a strong private sector sponsor

In selecting a private partner for the successful implementation of a PPP contract, it is critical for governments to undertake a wider assessment of the capability of the sponsor to manage unexpected events as they occur. It is advisable that governments undertake thorough due diligence to establish whether or not the contract will deliver VfM. The South African government through National Treasury has factored VfM considerations into its PPP legislative framework which requires the accounting authority to obtain treasury approval that the PPP agreement meets the requirements of affordability, VfM and substantial technical, operational and financial risk transfer as approved in terms of the applicable treasury regulation.

5.1.3 Good project and contract design

Projects need to be bankable in order to attract private sector investment. Key aspects for project bankability are risk allocation, incentives and affordability. These aspects determine whether a project is good or bad. It is not sufficient to have a good project design without an equally good contract design. According to the Commonwealth Secretariat (2010), good contract design warrants that: (i) the processes and procedures for the PPP are clearly spelt out; and (ii) the measures for evaluating the performance of the PPP are clearly laid out. This means that all relevant aspects of the contract are clearly spelt out and that the approach and basis of contract evaluation are clear in order to avoid ambiguities.

5.2 Lesson 2: PPPs are a long term relationship between the public and private sectors

In a PPP framework, the role of government remains relevant over the full lifecycle of the project. This long term nature of PPPs has implications for the PPP framework, ongoing management of the contract and the skills and experience required in the public sector.

5.2.1 Establish a flexible PPP framework

The creation of a PPP framework enhances the long term success of PPPs. A PPP framework establishes rules of the game in that it provides a platform for ongoing dialogue and cooperation

between the public and the private sectors. The framework should not be rigid to an extent that it limits a process of renegotiation in cases where unexpected events occur which are beyond the control of either party.

5.2.2 Ensure effective ongoing management of the PPP contract

As highlighted earlier, the role of government remains relevant over the full lifecycle of the project. As such, efficient contract management and monitoring are key success of the project. Since the project is financed with public funds, government has an obligation to manage the PPP contract so as to ensure that the desired outcomes and expectations of the public are met. Key to this is the performance monitoring mechanism of the PPP which should keep track of possible deviations as well as consequence management whenever required.

5.2.3 The need for skilled personnel with the public sector

PPP are complex transactions which call for highly skilled and competent staff. It is important that both parties have the right skills set in order to implement PPP projects successful. The public sector personnel tasked with the responsibility to negotiate contracts with the private sector must possess specialist legal, financial and technical skills. In addition, there should be a regular and effective communication channel between the two parties.

5.3 Lesson 3: Avoid a rushed project development process

PPPs are by nature complex transactions and normally project development phases last a minimum of three years before finance is secured and any meaningful construction takes place. This has the potential to cause conflict with short term political dynamics. The Commonwealth Secretariat (2010) states that there can be a temptation for governments to short circuit the project development process in order to deliver on public expectations of improved services from a PPP programme. A high level political support as well as suitable management of political and public expectations on PPPs is crucial to their success. In addition given the complexity of PPPs, expert advice is very important.

5.3.1 High level political patronage is vital

Any project requires a champion: someone to articulate and refine the vision, guide process, and advocate for support. For PPPs, political champions are very vital, given the significant public stake in them (World Bank Group, 2014). It is essential that PPPs transactions have political champions within the government machinery who can drive these projects through required legislation and other regulatory processes. An effective PPP unit can play a very critical role in pushing PPP projects up the political agenda for broader public buy in. In addition, strong government commitment to PPPs would boost private sector confidence in investing in these projects.

5.3.2 Management of political expectations

It is advisable to avoid the temptation of ‘overselling’ PPP projects early in the project life cycle for political expediency because of the risk of creating unrealistic public expectations. It may be prudent to target ‘quick wins’ in order to build public support for the project. A good example within the South African context would be the upgrading of highways/freeways leading to the 2010 FIFA World Cup.

5.3.3 Relevant expert advice is expensive but necessary

Investing in expert advice in fields such as financial, legal and technical can be expensive but it is necessary due to the fact professionals with relevant international expertise and experience on PPPs are in scarce supply. This investment, according to the Commonwealth Secretariat (2010), is essential to ensure the project is properly designed and structured. It is equally

important that the public sector has access to high quality advisers to make sure that there is an equitable sharing of costs and risks with the private sector.

This paper confirms that developing a successful PPP programme is a complex undertaking which requires the public sector to have relevant skills levels as well as an appropriate legal and regulatory framework. It is only through the leveraging the strengths of both public and private sectors that PPPs as an alternative to the traditional procurement system, can become a vehicle for delivery public infrastructure which can boost economic growth for the developing economies in Africa.

6 References

- African Union Commission and Nepad Agency, 2011. *Infrastructure Development As Catalyst For Economic Growth In Africa*. Addis Ababa, African Union.
- Bhattacharya, A., Romani, M. & Steyn, N., 2012. *Infrastructure for development:meeting the challenge*. London, The Grantam Foundation.
- Bilal, S., 2013. Thematic Focus: Financing Infrastructure. *Great Insights*, 2(4), p. 1.
- Boston Consulting Group, 2013. *Strategic Infrastructure in Africa: A business approach to project acceleration*, Geneva: World Economic Forum.
- Bwanali, S. (2015). *The possible impact of establishing BRICS Development Bank for Infrastructure Development in Africa*, Unpublished Master of Business Leadership Degree Dissertation, University of South Africa (UNISA).
- Ernst & Young, 2012. *India Infrastructure Summit 2012: Accelerating implementation of infrastructure projects*, New Delhi: Ernst & Young Pvt Limited.
- Ondiege, P., Moyo, J. M. & Chouchane, A. V., 2013. *Developing Africa's Infrastructure for Enhanced Competitiveness* , New York: World Bank.
- Rwelamila, P.D., Snijder, F., 2008. *Public Private Partnerships as a Mechanism for Municipal Service Delivery in South Africa – The Case of Water Service at Elm: Montreal*
- Sheppard, R., Stephan, K. v. & Kumar, G., 2006. *Financing Infrastructure in Africa; How the region can attract more project finance*, Washington: The World Bank.
- The Commonwealth Secretariat, 2010. *Public Private Partnerships Policy and Practice*, London
- The Economist Intelligence Unit, 2015. *Evaluating the environment for public-private partnerships in Africa: The 2015 Infrascopes*. EIU, London
- The United States Department of the Treasury, 2015. *Expanding the Market for Infrastructure Public Private Partnerships*. Office of Economic Policy, Washington DC
- UNDP, 2012. *Innovative Financing for Development: A New Model for Development Finance*, New York: United Nations Development Programme.
- United Nations Conference on Trade and Development, 2013. *Supporting infrastructure development to promote economic integration:the role of the public and private sectors*. Geneva, United Nations.
- World Bank Group, 2014. *Overcoming Constraints to the financing of Infrastructure*, New York: World Bank.

A STUDY OF THE RELATIONSHIP BETWEEN MATERIAL WASTE AND COST OVERRUN IN THE CONSTRUCTION INDUSTRY

Saidu, Ibrahim; Shakantu, Winston

Department of Construction Management, Faculty of Engineering, the Built Environment, and Information Technology, Nelson Mandela Metropolitan University, Port Elizabeth, Eastern Cape, South Africa

Abstract

While wastage of materials has become a serious problem requiring urgent attention in the construction industry, cost overrun is a problem which affects 90% of completed projects in the world. The argument on how to eliminate cost overrun has been on-going for the past 70 years as on-site wastage of materials leads to increase in the final project cost. This paper examines the relationship between the causes of material waste and those of cost overrun at the pre-contract and post-contract stages of a project. The paper adopts the desktop methodological approach. This involves comparing the causes of material waste and those of cost overruns from the literature to determine the possible relationship. The result reveals that all the causes of material waste also cause cost overrun at the pre-contract and the post-contract stages of a project. However, 96.88% and 81.81% of the causes of cost overrun also cause material waste at the pre-contract and post-contract stages respectively. There is an 86.74% overlap between the causes of material waste and those of cost overruns at all stages of a project. Other causes which are not related are mostly, the micro-economic and macro-economic factors. Based on these findings, it can be concluded that effective management of material waste would translate into a reduction in the level of project cost overrun. The study recommends that construction-project managers as well as the construction practitioners should encourage the management of material-waste causes, as it has the potential to minimise the causes of cost overrun for a project.

Keywords: Construction Industry, Cost overruns, Contract wtages, Material waste

1 Introduction

The construction industry is one of the driving forces behind the socio-economic development of any nation. However, it is faced with the severe problems of cost overruns, time overruns, and construction waste (Abdul-Rahman *et al.*, 2013; Osmani *et al.*, 2008; Nagapan *et al.*, 2012). Material wastage has become a serious problem, which requires urgent attention in the construction industry and it has affects the delivery of many projects (Adewuyi and Otali, 2013).

The problem of construction waste all over the world remains unresolved, as has been shown by various authors reporting on the situation: for example, 28.34% of the total waste sent to landfills in Malaysia originates from construction activities (Begum *et al.*, 2007): the US generates 164million ton of construction waste annually representing 30-40% of the country's Municipal Solid Waste (MSW) (Osmani, 2011): China alone generates 30% of the world's MSW, out of which construction and demolition waste represents 40% of the country's MSW

(Lu and Yuan, 2010): and 10% of the materials delivered to sites in the UK construction industry end up as waste that may not be accounted for (Osmani, 2011). Accordingly, Ameh and Itodo (2013) noted that for every 100 houses built, there is sufficient waste material to build another 10 houses.

On the other hand, cost overrun is a common problem in both developed and developing countries which makes it difficult for many projects to be completed within their budgeted cost (Memon *et al.*, 2013). Being a common problem, cost overrun was found across twenty nations and five continents of the world (Allahaim and Liu, 2012). The argument in the construction industry on how to reduce or totally remove cost overruns from projects has been on-going among the built environment professionals, project owners, and the users for the past seventy years (Apolot *et al.*, 2010; Allahaim and Liu, 2012), but there is no substantial improvement nor significant solution in mitigating its detrimental effects (Allahaim and Liu, 2012); while on-site wastage of material leads to increase in the final cost of a building project. As materials are wasted, more is required, thereby affecting the estimated cost of the project (Ameh and Itodo, 2013; Teo *et al.*, 2009). This is regardless of the 5% allowance made to materials in the process of bill-of-quantities production in order to take care of waste. Moreover, Ameh and Itodo (2013) reported that in the UK, material waste accounts for an additional 15% of construction project cost overruns and also accounts for about 11% of construction cost overruns in Hong Kong. In the same vein, a study conducted in the Netherlands revealed a cost overrun of between 20-30% as a result of construction-material wastage. Ameh and Itodo (2013) emphasise that most managers of construction projects pay little attention to the effects of material waste generated on cost overrun. Many studies have been carried out in this field, but still, there is need for a research that provides an objective assessment of the relationship between the causes of material waste and those of cost overrun in the construction industry. Hence, this paper examines the relationship between the causes of material waste and those of cost overruns with a view to suggesting the possible ways of minimising their effects at the pre-contract and the post-contract stage of a project.

2 Literature Review

2.1 Relationship between material waste and construction cost overrun

Construction waste is generally classified into two, namely: the physical waste and the non-physical waste (Nagapan *et al.*, 2012). Physical construction waste is the waste from construction, renovation activities, including civil and building construction, demolition activities, and roadwork. It is, however, referred by some directly as solid waste: the inert waste which comprises mainly sand, bricks, blocks, steel, concrete debris, tiles, bamboo, plastics, glass, wood, paper, and other organic materials (Nagapan *et al.*, 2012 and Ma, 2011). This type of waste consists of a complete loss of materials, due to the fact that they are irreparably damaged or simply lost. The wastage is usually removed from the site to landfills (Nagapan *et al.*, 2012).

Conversely, the non-physical waste normally occurs during the construction process. By contrast with material waste, non-physical waste relates to time and cost overruns for a construction project (Nagapan *et al.*, 2012). Similarly, Ma (2011) defines waste as not only associated with wastage of materials, but also to other activities such as repair, waiting time, and delays. Besides that, waste can be considered as any inefficiency that results in the use of equipment, materials, labour, and money in the construction process. In other words, waste in construction is not only focused on the quantity of materials on-site, but also overproduction, waiting time, material handling, inventories, and unnecessary movement of workers (Nagapan *et al.*, 2012). Memon *et al.* (2014) added that non-physical waste includes undesired activities, which can cause the physical waste, such as rework, unnecessary material movements, and so

forth. Figure 1 shows the general classification of construction waste and further depicts that, since construction waste entails both the physical and the non-physical waste, there is a relationship between material waste originating from the physical waste and cost overrun from the non-physical waste, since they originate from the same waste family. This is supported by the summary of the causes of material waste and those of cost overrun in Table 1.



Figure 1. Classification of construction waste (Source: Nagapan *et al.*, 2012)

2.2 The pre-contract stage of a project

The pre-contract stage of a project comprises a lot of activities from the inception to the final stage of award of contract. These activities include the feasibilities, outlined proposal, scheme design, detail design, bills of quantities/estimation, and so forth. These activities, if not properly managed and controlled, would contribute to the generation of material waste and cost overruns (Ashworth, 2008). Hence, it is appropriate to understand the main causes of material waste that relate to the causes of cost overrun at this stage of a project.

2.3 The post-contract stage of a project

The activities involved in the post-contract stage of a project include the following: construction on site, supervision, inspection, approvals, valuations, completion, hand over to client and user occupation, correction of defects, and completion of contract requirements and settlement of the final accounts (Ashworth, 2008). However, this aspect of research would only focus on construction related issues.

3 Research Methodology

The research employed the desktop methodological approach. This involves comparing the causes of material waste and those of cost overruns from the review of the related literature in order to determine the possible relationship. The relevant secondary source of data for this research include: published materials (books, journals) and unpublished reports, such as: periodicals, conference proceedings, building codes, and policies and guidelines relating to material waste and cost overruns in the construction industry.

The analysis was performed by comparing the causes of material waste and those of cost overrun identified from the literature. The results were expressed in frequencies and percentages and presented in tables and figures. The causes of material waste that relate to those of cost overruns are ticked as shown in Tables 1 and 2.

4 Findings and Discussion

4.1 The pre-contract stage of a project

Table 1 reveals that the causes of material waste and those of cost overruns identified from the literature are similar. These causes occur as a result of one, or combination of several causes at the pre-contract stage of a project and they are very important to identify for effective cost performance and sustainable construction.

All the causes of material waste were also found to be identified as the causes of cost overrun at the pre contact stage of a project but not *vice versa*. For instance, the causes of cost overrun and those of material waste in Table 1 shows that, 31 out of the 32 causes of cost overruns considered at the pre-contract stage of a project also cause material waste showing a 96.88%

relationship (pre-contract stage). Reason being that ‘the practice of assigning the contract to the lowest bidder,’ which is a cause of cost overrun is not a cause of material waste.

Table 1. Causes of material waste found in the causes of cost overruns at the pre-contract stage

S/N	Causes of Cost overrun	Cost overrun	Material waste
1	Design error	✓	✓
2	Deficiencies in cost estimates	✓	✓
3	Insufficient time for estimate	✓	✓
4	Improper planning at on stage	✓	✓
5	Political complexities	✓	✓
6	Insurance problems	✓	✓
7	Changes in material specification	✓	✓
8	Laws and regulatory framework	✓	✓
9	Poor design management	✓	✓
10	Practice of assigning contract to the lowest bidder	✓	x
11	Lack of experience of local regulation	✓	✓
12	Communication error among parties in planning	✓	✓
13	Poor knowledge of the changing requirements	✓	✓
14	Lack of design information	✓	✓
15	Designing irregular shapes and forms	✓	✓
16	Different methods used in estimation	✓	✓
17	Improper coordination	✓	✓
18	Delays in design	✓	✓
19	Optimism bias	✓	✓
20	Complicated design	✓	✓
21	Inadequate specifications	✓	✓
22	Incomplete drawings	✓	✓
23	Inexperience designer	✓	✓
24	Error in design and detailing	✓	✓
25	Inadequate site investigation	✓	✓
26	Difficulties in interpreting specification	✓	✓
27	Delay in preparation and approval of drawings	✓	✓
28	Designing uneconomical shapes and outlines	✓	✓
29	Frequent demand for design changes	✓	✓
30	Poor communication flow among design team	✓	✓
31	Unsatisfactory budget for waste management	✓	✓
32	Lack of communication among parties at pre contract stage	✓	✓
Summary=31/32X100=96.88%			

(Sources: Le-Hoai *et al.*, 2008; Memon *et al.*, 2011; Love *et al.*, 2011; Allahaim and Liu, 2013; Olawole and Sun, 2010; Kasimu, 2012; Malumfashi and Shuaibu 2012; Nagapan *et al.*, 2012; Osmani *et al.*, 2008; Wahab and Lawal; 2011; Oladiran, 2009; Ameh and Itodo, 2013; Aiyetan and Smallwood, 2013; Osmani, 2011)

This relationship is further summarised in Figure 2, which shows that, at the pre-contract stage of a project, the causes of cost overruns also cause material waste. This means that all causes of material waste also cause anticipated cost overrun at the pre-contract stage of a project. But only 96.88% of the causes of cost overrun cause material waste. The remaining 3.12% ‘the practice of assigning the contract to the lowest bidder,’ are not related. This implies that, managing material waste at this stage denotes managing a 96.88% of cost overruns.

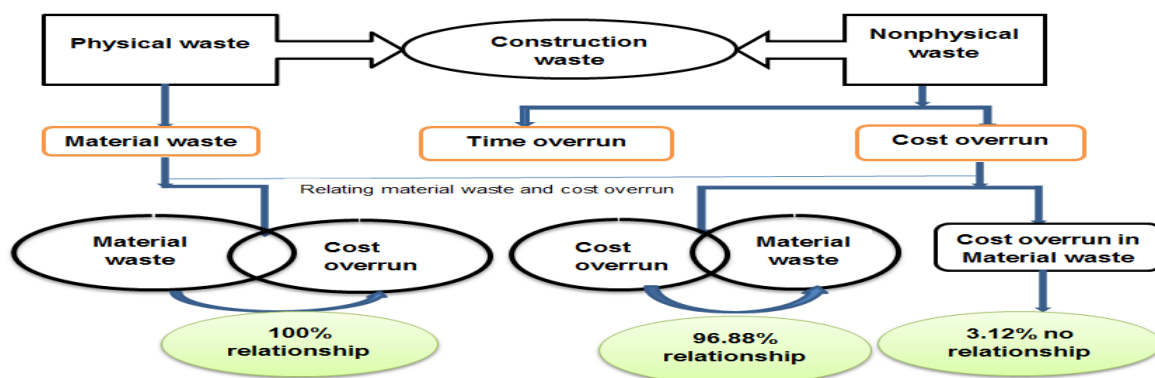


Figure 2. Relationship between cost overruns and material waste at pre-contract stage

4.2 The post-contract stage of a project

Table 2 shows the causes of cost overrun that are related to the causes of material waste at the post-contract stage of a project. Out of the 66 causes of cost overruns considered, 54 also cause material waste showing an 81.81% relationship at the post contract stage of a project.

Table 3. Causes of material waste found in causes of cost overrun at post-contract stage

S/ N	Causes of Cost overrun (post-contract stage of project)	Cost overrun	Material waste	S/N	Causes of Cost overrun (post-contract stage of project)	Cost overrun	Material waste
1	Monthly payment difficulties	✓	x	34	Unforeseen geological conditions	✓	✓
2	Poor planning by contractors	✓	✓	35	Financial difficulties of contractor	✓	✓
3	Heritage material discovery	✓	✓	36	Social and cultural impact	✓	✓
4	Market conditions	✓	x	37	Inaccurate site investigation	✓	✓
5	Cash flow and financial difficulties faced by contractors	✓	x	38	Inadequate use of modern equipment & technology	✓	✓
6	Slow information flow between the parties	✓	✓	39	Obtaining materials at official current prices	✓	x
7	Escalation of material prices	✓	x	40	Labour problems	✓	✓
8	Increase in wages	✓	x	41	Increase in material prices	✓	x
9	Poor management assistance	✓	✓	42	Owner interference	✓	✓
10	Exchange rate fluctuation	✓	x	43	Slow payment of works	✓	x
11	Deficiencies in the social structure	✓	✓	44	High interest rate charged by bankers on loans	✓	x
12	Additional works	✓	x	45	Fraudulent practices	✓	✓

13	Optimism bias	✓	✓	46	Labour disputes and strike	✓	✓
14	Labour cost increased due to environment restriction	✓	x	47	Improper coordination amongst parties at post contract stage	✓	✓
15	Insufficient equipment	✓	✓	48	Poor technical performance	✓	✓
16	Deficiencies in the infrastructure	✓	✓	49	Equipment availability/failure	✓	✓
17	Lack of communication among parties	✓	✓	50	Number of works being done at same time	✓	✓
18	Change in the scope work	✓	✓	51	Poor financial control on site	✓	✓
19	Delay payment to supplier/subcontractors	✓	✓	52	Poor site management and supervision	✓	✓
20	Shortage of materials	✓	✓	53	Site constraint	✓	✓
21	On-site waste	✓	✓	54	Lack of skilled labour	✓	✓
22	Project size	✓	✓	55	Mistakes during construction	✓	✓
23	Lack of constructability	✓	✓	56	Delay in decision making	✓	✓
24	Unrealistic contract duration	✓	✓	57	Shortage of site workers	✓	✓
25	Delay in material procurement	✓	✓	58	Disputes on site	✓	✓
26	Poor site management and supervision	✓	✓	59	Late materials/equipment delivery	✓	✓
27	Inexperience contractor	✓	✓	60	Unpredictable weather condition	✓	✓
28	Shortage of site workers	✓	✓	61	Mistakes during construction	✓	✓
29	Work security problem	✓	✓	62	Unforeseen site conditions	✓	✓
30	Rework	✓	✓	63	Earth conditions	✓	✓
31	Experience in contract	✓	✓	64	Management-labour relationship	✓	✓
32	Workers problems health	✓	✓	65	Inexperience of project location	✓	✓
33	Unexpected subsoil conditions	✓	✓	66	Lack of experience of project type	✓	✓

Summary=54/66X100=81.81%

(Source: Flyvbjerg, Holm, and Buhl, 2004; Singh 2009; Allahaim and Liu, 2013: 13-14; Olawole and Sun, 2010; Koushki, Al-Rashid and Kartam, 2005; Ejaz, Ali and Tahir 2011; Kasimu, 2012; Malumfashi and Shuaibu 2012; Le-Hoai, lee and lee, 2008; Memon *et al.*, 2011; Love *et al.*, 2011; Allahaim and Liu, 2013; Olawole 2010; Kasimu, 2012; Malumfashi and Shuaibu 2012; Nagapan *et al.*, 2012; Osmani *et al.*, 2008; Wahab and Lawal; 2011; Oladiran, 2009, Ameh and Itodo, 2013; Aiyetan and Smallwood, 2013; Osmani, 2011)

The relationships in Table 2 are further summarised in Figure 3 below showing that, at the post-contract stage of a project, there was also a 100% relationship between the causes of material waste and those of cost overruns. This means that, all material waste causes are also responsible for cost overruns. But on the other hand, when causes of cost overruns are considered, there is an 81.81% relationship with causes of material waste. The remaining 18.19% are not related and are mostly, the micro and macro-economic factors. This implies that managing material waste at this stage denotes managing 81.81% of cost overruns.

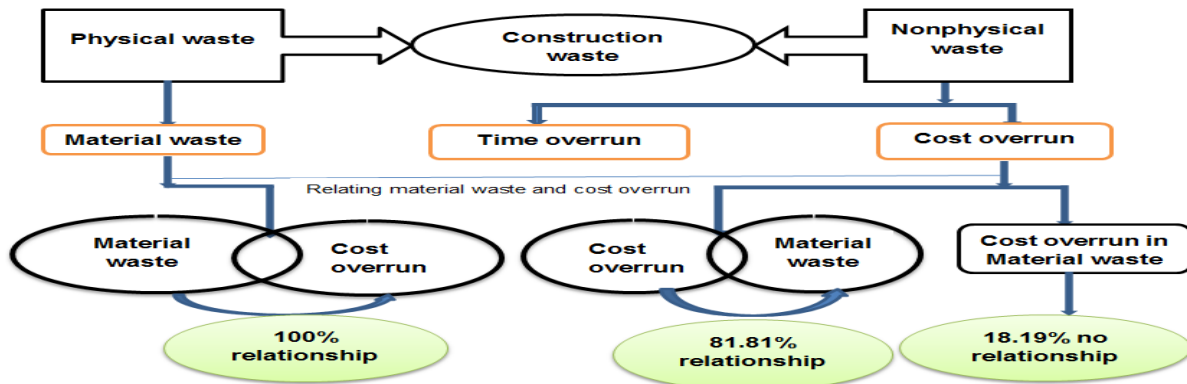


Figure 3. Relationship between cost overrun and material waste at the post-contract stage of projects

4.3 Pre-contract and post-contract stages of a project

Summing all the causes at both the pre-contract and the post-contract stages, $32+66=98$, a total of 85 out of 98 causes of cost overruns also cause material waste showing $85/98 \times 100 = 86.74\%$ relationship. These findings are also graphically represented in Figure 4.

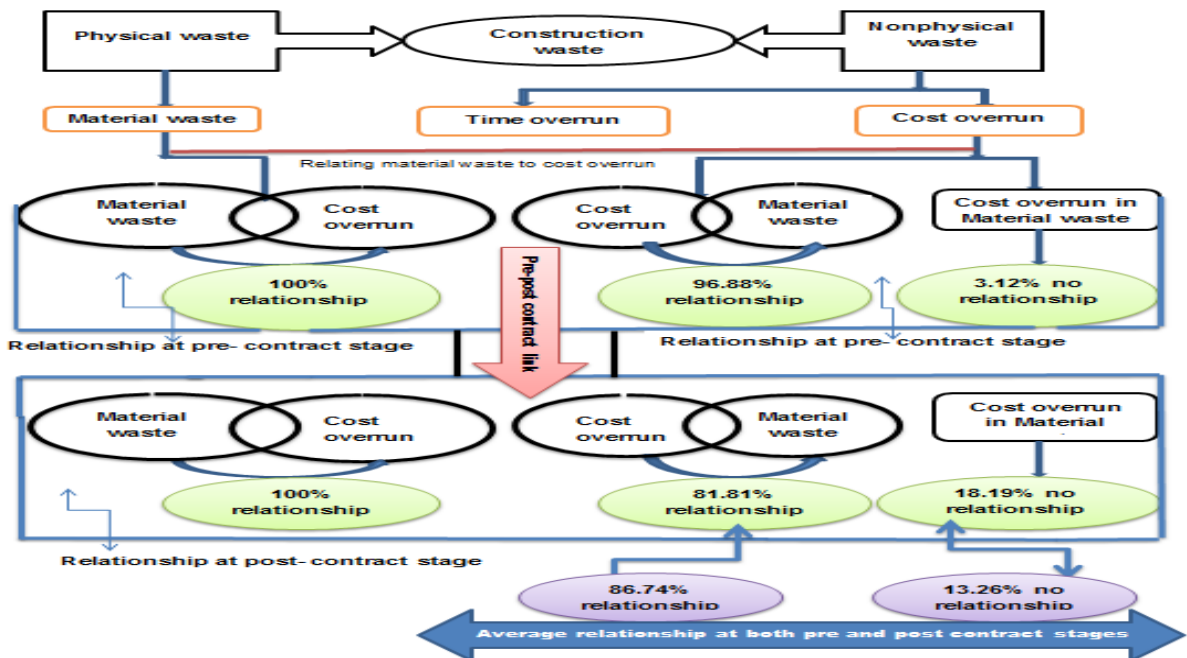


Figure 4. Relationship between material waste and cost overrun at all stages of a project

4.4 Managing material waste and cost overrun

Figures 5 and 6 show the interrelationship between project stages (pre-contract and post-contract), control measure, waste sources, waste causes and the identified percentage of cost overrun (86.74%). Figure 5 shows that unless control is tight at all sources and causes of material waste and at the stages of a project otherwise, cost overrun is bound to occur.

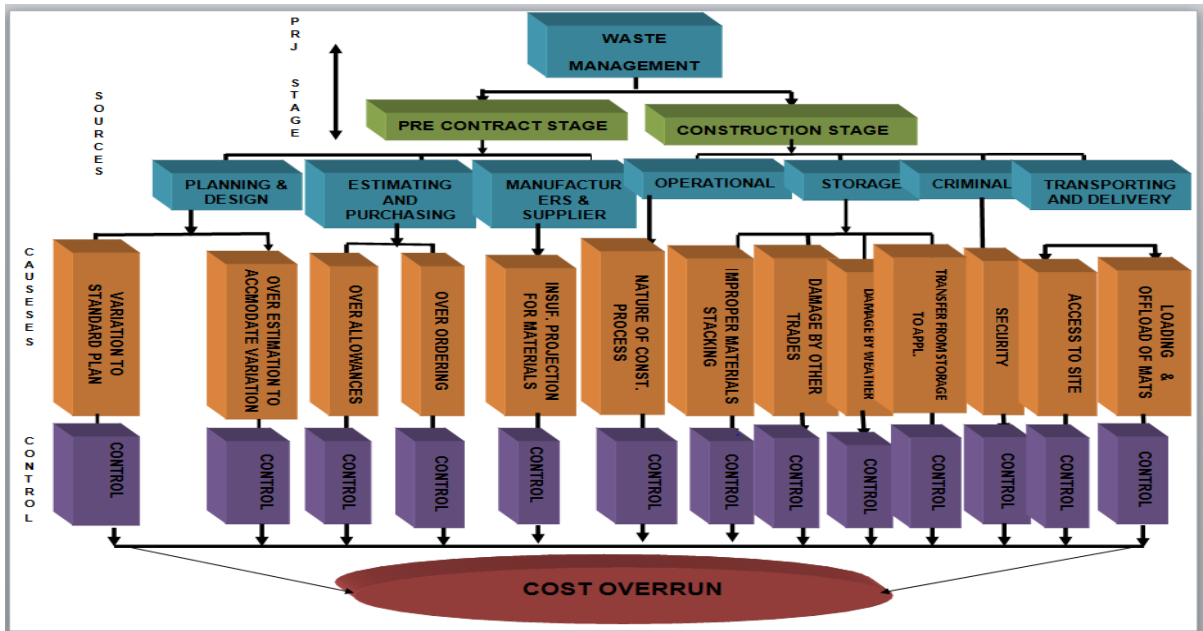


Figure 5. Summary of the relationship in Figure 4

This interrelationship is further represented in Figure 6.

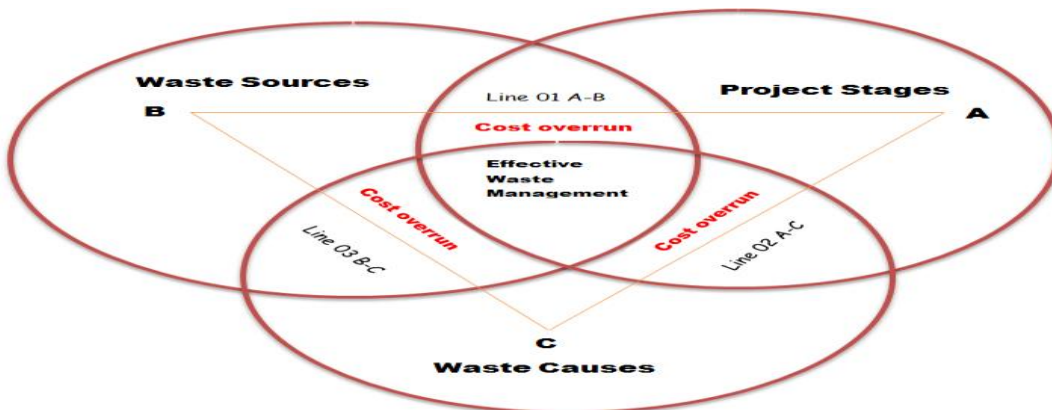


Figure 6. Relationship between project stages, waste sources, waste causes, management and cost overrun

This relationship is further represented mathematically showing how cost overrun is minimised with Effective Waste Management (EWM) from each scenario.

Line 01, A-B:

$$\text{Project stage} + \text{waste sources} - \text{EWM} = 86.74\% \text{ Cost overrun} \dots\dots\dots 01a$$

Making “EWM” the subject, by having a positive EWM, the equation would therefore, minimise cost overrun by 86.7%. This means that an effective waste management at the project stages and waste sources would effectively minimise project cost overrun by 86.7%.

$$\text{EWM} = \text{Project stage} + \text{waste sources} - 86.74\% \text{ Cost overrun} \dots\dots\dots 01b.$$

Line 02, A-C:

$$\text{Project stage} + \text{waste causes} - \text{EWM} = 86.74\% \text{ cost overrun} \dots\dots\dots 02a$$

$$\text{Project stage} + \text{waste causes} - 86.74\% \text{ cost overrun} = \text{EWM} \dots\dots\dots 02b$$

This means that an effective management (EWM) of waste causes at project stages would effectively minimise project cost overrun by 86.7%.

Line 03, B-C:

Waste causes+ waste sources-EWM=86.74% cost overrun.....03a

Collecting the like terms by making “EWM” the subject, the equation will be:

Waste causes+ waste sources-86.74% cost overrun=EWM.....03b

Therefore, an “EWM” would minimise the occurrence of “cost overrun” by 86.74%. However, Poor “EWM” would lead to occurrence of “cost overrun” as shown in the equation below:

–EWM= Project stage + waste sources+86.74% cost overrun.

Scenario 1 (Line 01, A-B), shows that waste sources within the project stage. Figure 6; cause an 86.74% cost overrun. Therefore, to effectively control the project waste, there must be an Effective Waste Management (EWM) at the project stages and at the waste sources, which will in turn, minimise cost overrun to 13.26%. The same applies to the remaining two scenarios.

These findings imply that an increase in material wastage on site leads to a corresponding increase in the amount of cost overruns for a project. 100% of the causes of material waste also cause cost overruns at the pre-contract and the post-contract stages of a project, while 96.88% and 81.81% of the causes of cost overruns cause material waste at the pre-contract and at the post-contract stages respectively. These results corroborates the findings of the studies conducted in the UK, Hong Kong, Netherlands, and Nigeria; that wastage of construction materials contributes to additional project cost by reasonable percentages (Ameh and Itodo, 2013). The result also supports the findings of Teo, Abdelnaser and Abdul (2009).

Though, these results are literature based, they however, refute the findings reported by Ameh and Itodo (2013: 748) that in the UK, material waste accounts for an additional cost of 15% to cost overruns as stated in the section 1 of this study.

5 Conclusions and Further Research

Material waste and cost overrun are identified as global problems which affect the success of many construction projects. Moreover, most managers of construction projects pay little attention to the effects of waste generated on cost overrun (referring to section 1). The aim of this research was to examine the relationship between the causes of material waste and those of cost overruns with a view to suggesting the possible ways of minimising their effects at the pre-contract and the post-contract stage of a project. The study concludes from the findings that effective management of material waste would translate into a reduction in the level of cost overrun for a project. It is recommended that construction-project managers as well as the construction practitioners should encourage the management of material-waste causes, as it has the potential to minimise the causes of cost overrun for a project.

Since this is an ongoing research, further study would focus on the collection of empirical (field) data on the issues relating to material waste and cost overruns in the construction industry.

6 References

- Abdul-Rahman, I., Memon, A.H. and Abd. Karim, A.T. (2013). Significant Factors Causing Cost Overruns in Large Construction Projects in Malaysia. *Journal of Applied Sciences*, 13(2), 286-293.
- Adewuyi, T. O. and Oтали, M. (2013). Evaluation of Causes of Construction Material Waste: Case of River State, Nigeria. *Ethiopian Journal of Environmental Studies and Management*, 6, 746-753.
- Aiyetan, O. and Smallwood, J. (2013). Materials Management and Waste Minimisation on Construction Sites in Lagos State, Nigeria. *Proceedings of the 4th International*

- Conference on Engineering, Project, and Production Management (EPPM) 2013, 1161-1172.*
- Allahaim, F.S. and Liu, L. (2012). Cost Overrun Causes, the Framework in Infrastructure Projects: Toward a Typology. *37th Australian University Building Educators Association, International Conference (AUBEA, 2012) Sydney, University of NSW (UNSW)*, 1-15.
- Ameh, J. O. and Itodo, E. D. (2013). Professionals' Views of Material Wastage on Construction Sites. *Organization, Technology and Management in Construction. An International Journal*, 5(1), 747-757.
- Apolot, R. Alinaitwe, H. and Tindiwensi, D. (2010). An Investigation into the Causes of Delay and Cost Overrun in Uganda's Public Sector Construction Projects: In , *Second International Conference on Advances in Engineering and Technology*, 2010, Uganda, 305-311.
- Ashworth, A. (2008). *Pre-Contract Study Paper Back: Development Economics, Tendering and Estimating*. Third edition, London: Blackwell publishing.
- Begum, R. A. Siwar, C. Pereira, J. J. and Jaafar, A. (2007). Implementation of Waste Management and Minimisation in the Construction Industry of Malaysia. *Resources, Conservation and Recycling*, 51, 190–202.
- Kasimu, M.A. (2012). Significant Factors that Cause Cost Overrun in Building Projects in Nigeria. *Interdisciplinary Journal of Contemporary Research in Business*, 3(11), 775-780.
- Le-Hoai, L. Lee, Y.D. and Lee, J.Y. (2008). Delay and Cost Overrun in Vietnam, Large Construction Projects: A Comparison with Other Selected Countries. *KSCE Journal of Civil Engineering*, 12(6), 367-377.
- Love, P. Edwards, D. and Irani, Z. (2011). Moving Beyond Optimism Bias and Strategic Misrepresentation: An Explanation for Social Infrastructure Project Cost Overruns. *IEEE Transaction on Engineering Management*. 12.
- Lu, W. and Yuan, H. (2010). Exploring Critical Success Factors for Waste Management in Construction Projects of China. *Resources, Conservation and Recycling*, 55, 201–208.
- Ma, U. (2011). *No Waste: Managing Sustainability in Construction*. Surrey: Gower Publishing Limited. 118-120
- Malumfashi, B.I. and Shuaibu, I. (2012). Risk Management and Cost Overrun in Infrastructure Projects in Nigeria. *Journal of Environmental Sciences and Policy Evaluation*, 2(2), 19-31.
- Memon, A. Abdul-Rahman, I. and Abdul-Aziz, A. (2011). Preliminary Study on Causative Factors Leading to construction Cost Overrun. *International Journal of Sustainable Construction Engineering and Technology*, 2 (1), 57-71.
- Memon, A.H. Abdul-Rahman, I. Zainun, N.Y. and Abd-Karim, A.T. (2013). Web-based Risk Assessment Technique for Time and Cost Overrun (WRATTCO)–A Framework. *Procedia-Social and Behavioral Sciences*, 129, 178 – 185.
- Memon, A.H. Abdul-Rahman, I. and Memon, I. (2014). Rule Based DSS in Controlling Construction Waste. *Life Science Journal*, 11 (6), 417-424.
- Nagapan, S. Abdul-Rahman, I. Asmi, A. and Hameed, A. (2012). Identifying the Causes of Construction Waste-Case of Central. *International Journal of Integrated Engineering*, 4(2), 22-28.
- Oladiran, O. J. (2009). Causes and Minimization Techniques of Materials Waste in Nigerian Construction Process, *Fifth International Conference on Construction in the 21st Century (CITC-V); Collaboration and Integration in Engineering, Management and Technology*, 20-22, May 2009, Istanbul, Turkey.

- Olawole, Y. A. and Sun, M. (2010). Cost and Time Control of Construction Projects: Inhibiting Factors and Mitigating Measures in Practice, *Construction Management and Economics*, 28(5), 509–526.
- Osmani, M. (2011). Construction Waste. Chap. 15 in *Waste: A handbook for management*, by Letcher and Vallero, 1-565. San Diego: Academic Press an imprint of Elsevier.
- Osmani, M. Glass, J. and Price, A.D.F. (2008). Architects' Perspectives on Construction Waste Reduction by Design. *Waste Management*, 28, 1147–1158.
- Teo, S.P. Abdelnaser, O. and Abdul, H.K. (n.d.). Material Wastage in Malaysian Construction Industry. *International Conference on Economics and Administration, Faculty of Administration*, University of Bucharest Romania, 257-264.
- Wahab, A. B. and Lawal, A. F. (2011). An Evaluation of Waste Control Measures. *African Journal of Environmental Science and Technology*, 5(3), 246-254.

A CONCEPT: STRATEGIC MAINTENANCE MANAGEMENT FOR BUILT FACILITIES OF UNIVERSITIES

Adamu, Anita Dzikwi; Shakantu, Winston

Department of Construction Management, Faculty of Engineering, the Built Environment, and Information Technology, Nelson Mandela Metropolitan University, Port Elizabeth, Eastern Cape, South Africa

Abstract

The built facilities of universities are essential facilities that are procured to support smooth administration of the primary functions of the institutions, which is the dissemination of specialist knowledge that will boost development of human capital. However, the degree of deterioration of built facilities at many educational institutions, including universities has been hinged majorly on ineffective maintenance management systems. To address problems related to ineffective maintenance systems, a strategic approach to maintenance management has been suggested by researches in the maintenance related fields both in the building construction and the manufacturing industries. This paper provides an understanding of the concept of maintenance management of built facilities using the strategic management approach. The methodology adapted for this investigation was basically an intensive literature review of related publications that underpin the theories and concepts of maintenance and strategic management. The exercise enabled an indepth understanding of the importance of strategic management principles towards achieving an effective maintenance management system for built facilities. The articulated concepts and principles from the existing theories of which maintenance management is imbedded informed the concept of strategic maintenance management which is needful for managing the esteemed built facilities of universities. The paper recommends the integration strategic maintenance management principles in the development of a maintenance management system by maintenance management unit/department of universities.

Keywords: Maintenance management, Strategic management, Built facilities, Universities

1 Introduction

Maintaining built facilities in best possible condition on a university campus is important for the well-being of the staff and students that use or occupy these facilities (Iyagba, 2005). Maintaining buildings is an optimum initiative and intervention for preserving and supporting the values of the built environment and the entire community (Dann *et al.*, 2005; Idrus *et al.*, 2009).

Unfortunately, maintenance of buildings and incorporated facilities in many organisations including universities is perceived to be of less important as compared to construction or procuring new facilities (Cleote, 2002). However, maintenance has a major influence on the reliability and safety of buildings (Abdul Lateef *et al.*, 2010), therefore, well defined strategies are vital for maintaining all facilities in the best condition possible (Buys and Nkado, 2006),

that will create a conducive environment for academic activities which is the prime function on any university campus.

The consequences of neglecting maintenance in the built environment are less visible in the short-term, and as a result, management groups short-sightedly cut down maintenance budgets (Mc Duling *et al.*, 2004). In the United Kingdom (UK), Chanter and Swallow (2007) have observed a decline in the condition of built assets of educational institutions since the early 1980s, which they hinged on resource constraints. According to Adenuga *et al.* (2010) the United Nations (UN) Centre for Human Settlements found that many Developing Countries (DCs) lack effective maintenance management systems for the efficient utilisation of available resources. In addition, Bowazi and Buys (2009) observed that these DCs lack adequate maintenance policies to guide the maintenance operations of their built environments. Cloete (2002) also found that information on the current condition and maintenance requirements are inaccurate and unreliable. Furthermore, maintenance management is not a strategic issue at most tertiary educational institutions in South Africa (Buys and Nkado, 2006).

2 Overview of the Concept of Maintenance

Maintenance is a key support function in building performance and it deserves a strategic position in the management structure in an organisation (Abdul Lateef, Khamidi and Idrus, 2010; Olanrewaju, 2013) because it ensures that the functional, structural and aesthetic conditions of the built facilities are upheld throughout their service life (Waziri and Vanduhe, 2013). In so doing, safety of occupants/users would be enhanced, and the quality of life of the community would be improved. However, the concept of the term ‘Maintenance’ has evolved from a non-core but integral production function in manufacturing to a strategic management function (Pintelon and Parodi-Herz, 2008). The evolution of maintenance is believed to be influenced by the changes in concept of maintenance function due to a steady growth in the realisation of its importance to achieving core goal of an organisation. Dunn (2003) argues that changes in the expectations of maintenance are linked to the perceptions about failure patterns of facilities and that these perceptions determines the maintenance approach that are adapted by managers. Dunn (2003) described four generations of maintenance perceptions and expectations over six decades (1940-2000). A summary of the decennial analysis is presented on Table 1.

Table 1. Concepts and expectation of maintenance

Generation	Concept	Expectation
the 1940s “Necessary evil”	“Fix after it breaks”	“All wear out.”
1960s “Technical matter”	Fix before it breaks” predict, plan, conscious of cost	Higher equipment availability Lower equipment life Lower maintenance cost
1980-1990s “Important for production”	Improve it” Value focus (minimise defects, improve precision, redesign)	Higher equipment availability & reliability Safety, product quality longer equipment life & cost efficiency
2000 “Strategic issue”	“Optimisation” Maintenance management (align vision, integrate skills, improve performance)	Excellence

(Source: Dunn, 2003)

2.1 First and Second Generation (Necessary Evil - Technical Matter)

In the first generation (1940s) the maintenance approach was mainly fundamental repair skills because facilities were expected to be fixed only when a failure occurs. This view changed in the 1960s because of a growing realisation that the life span of facilities could be increased which implies that the facilities could be used effectively and efficiently for a longer period. The need for cost reduction of maintenance activities informed the ushered in the second generation. In addition, the cost of maintenance is reduced. Thus, the maintenance approach for facilities generation that characterise the second generation of maintenance focuses majorly on scheduled overhauls, employing management techniques such as Program Evaluation and Review Technique (PERT) for planning and controlling the maintenance operations.

2.2 Third Generation (Technical Matter - Necessary for Productivity)

The early 1980s to the late 1990s witnessed another change in the concept and practice of maintenance management in many industries. Main changes in the expectations of maintenance that characterised the third generation (in addition to the second generation perspectives) are: the need for greater safety, reliability, a growing consciousness of sustainable environment and improvement in the quality of production. The focus was not only on availability but also on reliability. The pattern of failure by Nowlan and Heap (1978) known as the 'PF-curve' which is believed to have ushered in the concept of Reliability Centred Maintenance (RCM). The 'PF' concept is applicable to any facility, the 'P' represents part of the facility (likely failure point) is observed using a condition monitoring method, which enables identification of an impending failure. 'F' refers to the failure point as the letter suggests (Sondalini, 2007). RCM, focuses on sustaining the functionality of the facility while maximising its availability and reliability. The maintenance approach in the third generation which is the RCM concerns itself with condition monitoring, maintainability and reliability and considered at design stage of a facility that is achievable with teamwork and empowerment (Smith, 1993).

2.3 Fourth Generation (Necessity for Productivity - Strategic Issue in an Organisation)

Towards the end of the 1990s and early 2000, the concept of the term maintenance of built facilities changed especially in the manufacturing industry. Reason for the change in concept has been attributed to the heavy reliance on mechanised or built facilities for production by many organisations of both goods and services (Murthy *et al.*, 2002). Maintenance during this period is considered a strategic issue that requires strategic management skills to aid the planning and execution of maintenance operation programmes. According to Pintelon and Parodi-Herz (2008), the concept of maintenance in the generation fourth is realistically perceived and valued by facilities owners, owing majorly to the rapid changes in the construction and manufacture of facilities (changes in technology). Technical approaches to maintenance without strategic planning skills was no longer effective and efficient. A rethink on the maintenance management system was inevitable. Many manufacturing organisations consider maintenance as an internal or external partner for success in pursuing prime goals (Lee and Scott, 2009b; Khazraei and Deuse, 2011; Selvik and Aven, 2011). Smith and Hinchcliffe (2004) argue that the maintenance approach of the fourth generation is an improvement on the RCM.

2.3.1 Principles of Strategic Maintenance Management

The term 'maintenance management' combines two important and distinct functions viz. operational and managerial. The range of skills required for operational functions is very different from those required for managerial input. The operational aspect requires purely technical skills, while the managerial deals with decision making, precisely "*what and how to decide*" (Pintelon and Parodi-Herz, 2008). However, maintenance personnel are more

concerned with technical issues and less concerned with strategic plans of the maintenance department and the strategic goals of an organisation (Lee and Scott, 2009b). Therefore, an understanding of the relationship between executive management at a strategic level and maintenance personnel at an operational level is important for effective management of facilities maintenance functions.

The operational function consists of various tasks to be executed in accordance with a maintenance policy (Marquez and Gupta, 2006). This is necessary for achieving the maintenance objectives as set by an organisation for maintaining a facility and its associated services (Abdul Lateef *et al.*, 2010). The basic tasks in this process are corrective or preventive operations; where the former refers to all activities undertaken after the occurrence of a failure, the latter refers to activities in anticipation of a failure occurring (McLean, 2009). The execution of maintenance tasks involves one or a combination of the following activities: Service, rectification or replacement (Buys, 2004; Olagunju, 2011).

3 Research Methodology

An intensive literature search was conducted with the aid of maintenance related published journal articles, books, conference papers and a few unpublished PhD thesis. The concept of a strategic maintenance management for universities was articulated from the concepts and principles of maintenance management for facilities from the reviewed literature.

4 Strategic Maintenance Management

Maintenance management has evolved from a stand-alone technical function to a multi-functional process that involves key management units (strategic and operations managements) of an organisation (Yahya and Ibrahim, 2010). Therefore, strategic management plays an important role in the strategic maintenance process.

According to Tse (2010) “Strategic management is a process that requires the input of top management’s analysis of the environment in which the organisation operates prior to formulating a strategy, as well as the plan for implementation and control of the strategy”. Strategic management is in the domain of executive management of a university. Its main function in relation to maintenance management is the formulation of maintenance policies that will guide maintenance managers in preparing programmes and choice of maintenance strategy (Lee and Scott, 2009a). A strategy is insufficient and has little or no value to an organisation without a strategic plan for deployment and implementation of resources as well as operations (Wells, 2000). Major roles and importance of strategic management include:

- i. it has a major influence on maintenance management processes in an organisation because the maintenance objectives must align with the main objectives of the organisation (Yahya and Ibrahim, 2010);
- ii. the position of a maintenance department within an organisation is dependent on the strategic objectives of that organisation and the importance it attaches to the condition of its buildings (Chanter and Swallow, 2007); and
- iii. strategic management guides the formulation of maintenance policy, determines the strategic direction, approves the budget and other necessary resources for maintenance management (Lee and Scott, 2009b).

A strategic maintenance management is a world class maintenance management method used by many industries for optimizing the valuable assets such as built facilities. The maintenance process is considered a cost efficient which enables focus on resource management for best return on investment and avoids intrusive maintenance, it adapts performance evaluation

techniques which produces results that aids strategic planning to improve maintenance strategies (Smith and Hinchcliffe, 2004).

5 Conclusion and Further Research

This paper presented an evolutionary perspective of maintenance especially in the manufacturing industry. Understanding the strategic stand point of maintenance management is the crux of the study, which has been achieved through theoretical search. In conclusion, the paper contends that a sustainable maintenance management approach for built facilities in a university must integrate strategic management. In so doing, facilities serve for a longer period with minimal maintenance cost and the safety of users/occupants is also enhanced. Therefore, strategic maintenance management is recommended as a key agenda for preserving valuable built facilities that universities procure to support their primary goal of human capital development. The paper suggest an empirical study of current maintenance management systems at universities to enable the development of a framework and model for sustainable maintenance of their built assets.

6 References

- Abdul Lateef, O., Khamidi, M. and Idrus, A. (2011). Behavioural Issues in Maintenance of University Buildings. *Journal of Retail and Leisure property*, 9(5), 415-428.
- Adenuga, O. A., Olufowobi, M. and Raheem, A. (2010). Effective Maintenance Policy as a Tool for Sustaining Housing Stock in Downturn Economy. *Journal of Building Performamnce*, 1(1), 93-109.
- Bowazi, K., & Buys, F. (2012). Maintenance of University Facilities in Developing Countries. Cape Town: *International Conference on Facilities Management, Procurement Systems and Public Private Partnership*.
- Buys, F. and Nkado, R. (2006). A Survey of Maintenance Management Systems in South African Tertiary Institutions. *Construction Management and Economics*, 997-1005.
- Buys, N. (2004). *Building Maintenance Management Systems in Tertiary Institutions in South Africa*. University of Port Elizabeth: Unpublished PhD thesis in Construction Economics.
- Chanter, B. and Swallow, P. (2007). *Building Maintenance Management (2nd Ed.)*. Singapore: Fabulous Printers Ltd.
- Cloete, C. (2002). *Introduction to facilities management (1st Ed.)*. Sandton: South African Property Education Trust.
- Crespo Márquez, A., Moreu de León, p., Gómez Fernández, J., Parra Márquez, C. and González, V. (2009). The Maintenance Management Framework: A practical view to maintenance management. In *Safety, Reliability and Risk Analysis: Theory, Methods and Applications*, 669-674.
- Dann, N., Hills, S. and Worthing, D. (2006). Assessing how Organisations Approach the Maintenance Management of Listed Buildings. *Construction Management and Economics*, 24(1), 97-104.
- Dunn, S. (2003). The Fourth Generation of Maintenance. Australia: *Conference Proceedings of International Conference of Maintenance Societies (ICOM)*, Perth.
- Idrus, A., Khamidi, F. and Abdul Lateef, A. (2009). Value-based Maintenance Management Model for University Buildings in Malaysia. *Journal of Sustainable Development*, 2(3), 127-133.
- Igba, J., Alemzadeh, K., Anyanwu-Ebo, I., Gibbons, P. and Friis, J. (2013). A systems approach towards reliability-centred maintenance (rcm) of wind turbines. *Procedia Computer Science*, 16, 814-823. doi:http://dx.doi.org/10.1016/j.procs.2013.01.085
- Iyagba, R.O.A (2005). The menace of sick building: A challenge to all for its prevention and treatment. *Inaugural lecture series*, Lagos: University of Lagos Press.

- Khazraei, K. and Deuse, J. (2011). A strategic Standpoint on Maintenance Taxonomy. *Journal of Facilities Management*, 9(3), 96-113.
- Lee, H. and Scott, D. (2008). Development of a Conceptual Framework for the Study of Building Maintenance Operation Process in the Context of Facility Management. *Surveying and Built Environment*, 19(1), 81-101.
- Lee, H. and Scott, D. (2009). Strategic and Operational Factors' Influence on the Management of Building Maintenance Operation Process in Sports and Leisure Facilities. *Journal of Retail and Leisure Property*, 25-37.
- Lee, H. and Scott, D. (2009). Overview of Maintenance Strategy, Acceptable Maintenance Standard and resources from a Building maintenance Operation Perspective. *Journal of Building Appraisal*, 4(4), 269-278.
- Marquez, A. and Gupta, J. (2006). Contemporary Maintenance Management: Process, framework and supporting Pillars. *International Journal of Management Science*, 313-326.
- Mc Duling, J., Harok, E. and Cloete, C. (2004). Quantifying the Consequences of Maintenance Budget Cuts. Cape Town: ICEC World Congress.
- Mclean, S. (2009). Why does Maintenance Planning Require a Bespoke Approach, *Journal of Building Appraisal*, 5(1), 1-5
- Munchiri, P., Pintelon, L., Gelders, L. and Martin, H. (2011). Development of Maintenance Function Performance Measurement Framework and Indicators. *International Journal of Production Economics*, 131, 295-302.
- Murthy, D. N. P., Atrens, A. and Eccleston, J. A. (2002). Strategic maintenance management. *Journal of Quality in Maintenance Engineering*, 8(4), 287-305.
- Nowlan, F. S., & Heap, H. F. (1978). Reliability-centered maintenance. Retrieved from DTIC Document United Airlines Publications: Report A066-579
- Olagunju, R. E. (2011). *Development of Mathematical Models for the Maintenance of Residential Buildings in Niger State*. Federal University of Technology, Minna, Nigeria: Unpublished Ph.D. Thesis.
- Olanrewaju, A. A. (2010). 'Quantitative analysis of criteria in university building maintenance in Malaysia'. *Journal of Construction Economics and Building*, 10(3), 51-61.
- Pintelon, L. and Parodi-Herz, A. (2008). Maintenance: An Evolutionary Perspective. In D. N. K. A. H. Kobbacy, *Complex System Maintenance Handbook* (pp. 21-28). London: Springer Series in Reliability Engineering.
- Selvik, J. T. and Aven, T. (2011). A framework for reliability and risk centered maintenance. *Reliability Engineering & System Safety*, 96(2), 324-331.
- Smith, A. M. and Hinchcliffe, G. R. (2004). 1 - World class maintenance (wcm)—opportunity and challenge. In A. M. Smith & G. R. Hinchcliffe (Eds.), *Rcm* (pp. 1-18). Burlington: Butterworth-Heinemann.
- Tse, E. (2010). *Fundamentals of Strategic Management* - SAGE publications. Retrieved May 19, 2014, from http://www.sagepub.com/upm-data/53794_Chapter_1.pdf
- Waziri, B., & Vanduhe, B. (2013). Evaluation of Factors Affecting Residential Building Maintenance in Nigeria: Users' Perspective. *Civil and Environmental Research*, 3(8), 19-24.
- Wells, D. (2000). *Strategic Management for Senior Leaders: A Handbook for Implementation*. Virginia: Total Quality Leadership Office.
- Yahya, M. R. and Ibrahim, M. (2010). Strategic and Operational Factors Influence on Building Maintenance Management Operation Process in Office High Rise Buildings in Malaysia. Kuala Lumpur: *1st International Conference on Sustainable Buildings and Infrastructure*.

- Zawawi, E., Kamaruzzaman, S., Ithnin, Z. and Zulkarnain, S. (2011). A Conceptual Framework for Describing CSF of Building Maintenance Management. *The 2nd International Building Control Conference Procedia Engineering*, 110 – 117.
- Zulkarnain, S., Zawawi, E., Rahman, M. and Mustafa, N. (2011). A Review of Critical Success Factor in Building Maintenance Management Practice for University Sector. *World Academy of Science, Engineering and Technology, International Science Index* 53, 5(5), 194-199.

EVALUATION OF THE GLOBALISATION READINESS OF MEDIUM SIZED CONTRACTORS IN THE SOUTH AFRICAN CONSTRUCTION INDUSTRY

Anugwo, Iruka C., Shakantu, Winston M.

Department of Construction Management, Faculty of Engineering, the Built Environment, and Information Technology, Nelson Mandela Metropolitan University, Port Elizabeth, Eastern Cape, South Africa

Abstract

The developing countries are on the verge of developmental take-off, most especially the African continent with its emerging economies. The current competitive forces are intense both on the global and domestic in the construction market. The global thrusts have generated the concepts of globalization business strategy as one of the drivers of competitiveness of many countries and organisations. The objective of this study is to evaluate the globalization readiness amongst the medium enterprise (MEs) contractors in Port Elizabeth, Eastern Cape Province of South Africa (SA). This paper is a qualitative study which adopted in-depth interviews for 10 contractors in the Civil Engineering and General Building contractors within the cidb grade 4 to 6 between the months September to October 2015. These MEs are perceived as potential large scale construction organisations in the nearest future. Findings of the study shows that most of the contracting firms interviewed are currently sustainable and competitive organisations in the domestic market but significantly lacking the readiness and the strategic business approach to penetrate and participate in the global construction market. It can be concluded that the competitive forces emanating from globalization thrust may have the capability to erode the potential and opportunities of the SA medium contractors for growing and maturing into large construction organisations in the African continent, due to lack of globalization business strategy amongst local contractors. This study recommended that the SA construction contractors should endeavour to develop and implement globalisational business strategies that would foster their global competitiveness.

Keywords: Competitiveness, Globalisation readiness, SME contractors, South Africa

1 Introduction

The global attention that African countries are receiving is due to its needed calls for massive infrastructure development and its maintenance that would worth around US\$100 billion per year on the continent over the next decade (KPMG, 2014). It is obvious that developing countries, most especially those in the Africa continent are on verge to take-off on its massive infrastructure and mega cities building projects development; and as such the construction organisations both the small, medium and large firms should be encouraged to take advantage of this strategic positioning in order to heighten its global competitiveness. Dlungwana & Rwelamila (2004:349) advise that industries in the developing countries such as South African construction industry must strategically enhance the capacity at the base levels in order to improve its readiness to deliver effectively on local and global projects. The local contractors’

readiness to deliver effectively on the future infrastructure projects would increase their competitiveness in the local and global construction market.

Martin (2010) and Orozco et al. (2011) note that current competitive forces are intense both on the global and domestic market. This has posed a major challenge for many industries including construction. Given the increasing pace of globalization in the commencement of the twenty-first century; it is imperative for domestic organizations in African continent it strategically tap into this upsurge of opportunities. However, it is crucially for South African construction industry to create the readiness to develop, compete and adopt business strategies that would embrace international business management approach. According to Porter (1985) competition remains the center-focus of firms in any given marketplace (locally and internationally). It streamlines a firm's activities and resources; and it can lead to innovation, a cohesive culture and competitiveness (Riley, 2012; Blunck, 2006).

Blunck (2006) reveals that competitiveness emanates from superior productivity or performance in a business environment. However, enhancing the survival rate and competitiveness of the construction industry should be one of the most important strategic tasks for construction players. The construction industry has been an important venture for material production and is playing an important role especially in today's conditions where the rate of industrialization and globalisation in this sector is growing fast. The construction industry is important for the South African and global economy. According to the ECORYS SCS Group (2011) and the National Research Council (2009:2), the construction industry is of strategic importance to the European Union (EU) countries and the U.S.A, as it delivers the buildings and infrastructure needed by the rest of the economy and society; and it is a major generator of jobs. The South African construction industry contributes about 3.7 and 4.0 of the country gross domestic product GDP in the year 2012 and 2013 respectively (Kumo et al., 2015). Therefore, it is vital to ascertain the survival rate and competitiveness; and globalisational readiness of the construction industry especially the MEs contractors. Thus, this paper seeks to evaluate the globalization readiness amongst the active medium enterprise (MEs) contractors in the South African construction business. It was necessary to engage with the medium contractors and organisations that participated in the study as they are been perceived as potential large scale construction organisations in the nearest future. The paper consists with synopsis of the related literature reviews on the MEs contractors' competitiveness and globalisational readiness and it subsequently depicts the research design and method adopted; and presentation of the findings and discussion as well as the conclusion and further research areas.

2 The Medium Contractors' Competitiveness and Globalisational Readiness

According to Ngowi et al. (2004) the competitive force of globalization in the construction industry (CI) has presented new opportunities and challenges which have an impact on all countries in different perspectives. It can be convinced that the globalisation tends would erode the competitive strengths of the local CI. The lack of tenacity and readiness amongst local CI contractors to participate actively in global construction market would consequently undermine any protection policy provided national government that intended to shed the local contractor from the harsh reality of global forces. Ngowi et al. (2004) maintain that construction firms in developing countries have no choice, but to develop skills capacity and tactically position and differentiate their organisations in the market in a way that would ensure their sustainability and competitiveness. Such would also create the readiness for them to compete both in the domestic and global market.

The numerous advances in communication technology, transportation and air travel, and contemporary knowledge on business management and strategies have made global business environment so conducive to initiate and develop a rapid expansion of international business on from any country in the world (Howes and Tah, 2003). According to the, KPMG Global Construction Survey 2013, it was found that, about half of 165 senior leaders in the construction and engineering industry globally, are strategically planning to move into new geographies and most of them focus their business direction towards the African continent, which has been listed as the most popular and prospect to run a business (KPMG, 2014). KPMG (2014) further revealed that most of the organisations that are planning to gain entrance in the construction market in African continent have their headquarters in Europe and the Middle East, and many of these organisations are small companies with a turnover of up to US\$5 billion.

These global thrusts have generated the concept of globalisation and internationalisation in today's business world. The concept of globalization and internationalization is a dominating source of competitiveness for countries and organisations, and well as economic sustainability in the global construction businesses. Globalisation is the movement of people, resources, goods, services, ideas, language and skills across international spaces (Ibrahim, 2013; Dlungwana and Rwelamila, 2004). According to Tallman and Fladmoe-Lindquist (2002), globalisation can be regarded as the managerial process of integrating worldwide activities into a single world strategy. This can be achieved through organisations managing business networks of differentiated, but integrated subsidiaries, affiliates, alliances and associations.

Globalization and internationalization of a business organisations as be regarded as one drivers of any countries competitiveness. Broadly, the World Economic Forum (2014) defines "competitiveness as a set of institutions, policies and factors that determine the level of productivity of a country". The World Economic Forum (2014) further asserts that the stability of the macro-economic environment in any country enhances or deters its holistic business survival and performance as it impacts significantly on a nation's general level of competitiveness. According to Orozco *et al.* (2011) the concept of competitiveness in the construction industry can be divided into four sections, namely the country, industry, firm and project. The World Economic Forum (2014) indicates that South Africa's competitiveness has fallen to 56th out of 144 countries in the Global Competitiveness index for 2014, compared to 2013 when it was ranked 53rd out of 148 countries. It can be said that the country's competitiveness factors are determinants of its firms' international competitiveness; because it is evident that a country's international competitiveness is represented by its firms' competitiveness in comparison to other countries' firms. More so, the government should endeavour to create an enabling environment for MEs contractors through provision of easy access to finance, and creating awareness regarding available technologies, business opportunities and innovation which would boost their productivity and competitiveness globally.

The concept of competitiveness at the industry level is often considered as the results of the strategies and actions of organisations that operate in it. According to Momaya (1998) competitiveness of an industry depends on its ability to obtain inputs at competitive terms, to gain effective value through efficient processes, effective application of business management practices and the successful marketing of its output to downstream industries and international markets. In addition, Momaya (1998) claims that there are three components and facets of competitiveness in the construction industry, namely, competitive assets (factor costs, human resources, industry infrastructure, technology, demand conditions, government); competitive processes (strategic management, formal business plans and models, implementation, human resources development, R&D synergies); and competitive performance (productivity, human resource, quality/effectiveness, cost, financial, international, technological). The relative

market positions of the construction organizations in a particular country would determine their survival rate and competitiveness in global landscape of its industry. The competitiveness of a country and its levels of industrial development impacts heavily on the firms that operate within the system. It is therefore important that a firm compares and defines its competitiveness as per its own strategy and management practices. A systematic evaluation of competitiveness will be of great help to firms. According to Depperu and Cerrato (2005) a firm's competitiveness can be treated as a dependent or independent variable: the first approach looks at competitiveness as driver of a firm's survival and performance whereas the second one considers competitiveness as an outcome of a firm's competitive advantages. However, the concept of competitive advantage is central in strategic and business management and model. Ambastha and Momaya (2004) add that understanding the firm's level of competitiveness helps to provide a broader and more comprehensive view on sources of competitiveness. These sources have been categorized under 'Asset', 'Processes' and 'Performance' on spectrum of strategic and operational levers both in local and international markets.

- Asset - includes firm's brand, reputation, culture, system, structure, human resources, and technology;
- Processes - involves strategy, innovations, competencies, capabilities, quality, persuasion power, flexibility, adaptability, IT applications, managing relationship, design and deploy talent, marketing, manufacturing; and
- Performance – consists of value creation, customer/client satisfaction, market share, productivity, new product/service development, price and cost, profitability.

Wadiwalla (2003) suggests that economic integration in Southern Africa has been enhanced significantly through assistance of regional protocols relating to trade, finance, investment, transport, telecommunications, laws, amelioration of cross border trade barriers, facilitating efficient movement of goods between countries and frameworks for good governance. This economic integration has brought about internationalization of business organisations. Ellis & Williams (1995) state that organisations should have integrated approaches to international business strategies (such as international business, strategic management, international finance, organisational development and international marketing) relating to international aspects of industries, companies and their strategies. Daly (1999) suggests that inter-national literally means between or amongst nations. The basic unit remains the nation, even as relations amongst nations become increasingly necessary and important. However, the integration of international business strategies into contemporary organisations is applicable to small businesses and contractors.

According to Daly (1999) globalisation is inevitable wave of the future in a business environment; because the process of globalization has eliminated the natural barriers over the protection for local economies, and it has brought together the standardized outputs; and businesses across different sectors and countries (Gonov and Genova, 2001).

However, it is a fact now, that globalisation impact in developing countries is real, irreverable, and it has potential force to eliminate all the uncompetitive organisations and contractors within the construction industry in Africa continent (Dlungwana & Rwelamila, 2004). The strategic readiness for the African organisations to harness globalisation as a competitive advantages is their last life-belt that will enable them to strategically weather the storms of globalisation. Tallman and Fladmoe-Lindquist (2002) globalisation stands as new dynamic and strategic dimension to do business, because there is potential for competitive advantage through globalization; because it has becomes an important source for knowledge transfer and new market development. According to Ofori (2000) globalization is an inescapable fact for the construction industries in developing countries. However, Africa continent is no longer

immune to external influences and cannot be insulated from global effects. Wadiwalla (2003) opined that South African construction organization have globalised as a result of expansion, diversification, deepening of trade and to eliminate the cyclical nature of the construction market within South Africa. Furthermore, Wadiwalla (2003) said that contracting business in Southern Africa is dominated by South African Contractors. However, recent, and massive penetration and domination of the Chinese, European and Indian contractors in African continent should be wakeup call for indigenous organisations.

3 Research Methodology

The study made use of the qualitative research method using in-depth interviewing. However, the phenomenology paradigm was adopted in order to holistically understand the phenomenon about the medium contractors' perspective on globalisational readiness. This method in the study is considered the most appropriate and effective to elicit useful and authentic information- experiences, opinions and perspectives through the interviews with the medium construction business owner's and executive managers as firms' representatives. The primary data for this study emanated from face-to-face interviews conducted in Port Elizabeth between the Months of September to October 2015 and on-going PhD research. The interviewees were ten (10) construction business owners and executive firms' representative under the Construction Industry Development Board (cidb) register of contractors in the civil engineering (CE) and general building(GB) organisations within grade 4-6 (medium contractors- see Table 1). The interviewees comprise those organizations that have been competitive and sustainable and; actively operating their business beyond five (5) years in the construction industry.

Table 1. The background profile of interviewees

Interviewee code	Organisational Position	Years of Experience in Industry	Highest Level of Education Qualification	Cidb register of contractors grade
CC1	Executive Member(Owner)	40 years	National Diploma	6 GB
CC2	Director (Owner)	17years	Matric	5 CE
CC3	Managing Director (Family Business)	24years	Bachelor's Degree	5CE
CC4	Director (Shareholder)	40years	Matric	5 GB
CC5	Executive Manager (Family Business)	30years	National Diploma	5CE
CC6	Manager (Owner)	7years	Matric (studying Bcom)	4GB
CC7	Director (Owner)	10years	Bachelor's Degree	4GB
CC8	Managing Director (Owner)	42years	National Higher Diploma	6CE
CC9	Director (Owner)	32years	National Higher Diploma	6CE
CC10	Executive Managing Member	13years	Bachelor's Degree	4CE

(Source: Anugwo and Shakantu, 2015)

The information gathered during the study interviews was analysed thematically. However, the interview was purposively composed into themes as its links and reflects that of the research questions. These themes were emerged by pertaining the research questions within globalizational readiness and participation; international business strategy; and strategic partnership with foreign organization(s), as it were emerged from the transcribed interviews. Although, the research population response rate may seems low, but the data collected was still

significant and meaningful as most interviewees (contractors) were business owners and had wealth of experience in the South African construction industry.

4 Findings and Discussion

Theme 1: Globalization Readiness and Participation

Interview question: *Does your organization have business plans of operating internationally? And why?*

The issue of global participation amongst the medium scale construction contractors is worrisome as it only one (1) organization is actively operating outside South African construction market whilst 70% of organization the interviewed indicates that they have no strategic business intention to engage in international construction market. CC-1 explained that: *“At this moment, you can call us international company because we got subsidiary in Namibia, and have started a new project this year in Oshakati”*.

The common challenges deterring the medium construction expanding the businesses internationally are; lack of awareness, readiness and knowledge on opportunities in the international construction markets, risks of resources transfers, lack of interests and resources; and strong attachment to have absolutely control in the activities of their organizations. The CC-3 *“our organization have not done international project, and to be honest with you, it is a matter of awareness. I think there are lots of business opportunities internationally, but we are not ready for it yet”*.

From the reviewed literature, it has been confirmed that about 165 senior leaders as small construction companies in Europe and the Middle East are strategically planning to penetrate and compete in the African continent as the continent expected to be spending about US\$100billion on infrastructure development and its maintenance per year. This notion presents the evidence that integration of international business and operational strategies is applicable to small businesses and contractors across the Africa continent, most especially those contractors who are proactive to strategically penetrate and to actively participate in the global construction markets. CC-2 *“At this point in time, our organization doesn’t have any business to engage in international construction market and I’m not in a position where I’m going to be looking for them”*, and other organization- CC-8, added that *“No, we don’t operate internationally and I don’t want to, because I’m too old and it is too risk”* and similar responses emanated from the contractor CC- 9, *“No, I have never really thought about operating internationally. It hasn’t crossed my mind to strategically expand or gain competitive advantage in our business through that way”*. It seems the readiness is greatly lacking amongst the contractors as CC-5 states *“Our organisation haven’t thought or create that readiness about expanding our business on international level, so we don’t engage in international business”*. Remarkably, it take a brave organization to explore into international construction business as; CC-4 responses was *“No, to go internationally, no we are not that brave enough to expand our business internationally”*

Coincidentally, both CC-7 and CC-10 contractors have a long-term strategic goal to grow their resource base nationally but not internationally. CC- 7 *“No, not yet. We are still developing our business locally, but we might get to the international in future, but not really sure”*. And according to CC-10 *“Not really operating internationally but we currently have the business plans to expand nationally for the next five years”*.

Theme 2: International Business Strategy

For an organization to operate successfully in international market it must possess a competitive international business strategy. However, various factors foster or deter an organization to consciously develop international business strategy for its business expansion;

and these are economic crisis, comfort zone, local opportunities and advantages, family concerns, technically and administrative challenges, international alliances. According to CC-1 *“We have strategically chosen to this route of international business because of the economic challenging here in South Africa and obviously for expansion of our business network”*. In addition, CC-2 *“Running a family business successfully and within the immediate local market, and trying to be strategically the market leader locally required you full time attention. However, our business is strategically structured, that we don’t have time to go and engage in an international businesses”*.

Interacting with foreign business organizations can stimulate local contractors’ interest to starts nursing the need and business ideas to develop business strategy and go into international business landscape. According to CC-6 *“our business, is tentatively developing international business strategy. I have been engaging on business trips specifically to China and I’m strategically studying and learning how the Chinese operate their businesses in terms of construction operation and management”*. Shockingly, some the organisations deliberately undermine globalization thrust in the construction international market especially in African continent. The contractors’ CC-7, CC-8 and CC-9 stated that it is unnecessary for them to develop globalization business strategy. However this notion is a warning flag as it’s capable for undermining the country as well as the continent globalization readiness and competitiveness within the global market. CC-7 *“We don’t have concrete strategic business plans on that direction”* and CC-8 *“Our organisation don’t have a business strategy for international activities because it not necessary for us”*. Whilst, CC-9 said *“We don’t have any international business strategy for our organisation because it not necessary for us as we always wanted to be a small organisation and strategically cope on our own”*. However, only one organization have a long term business plan to development international business strategy, as CC-10 said that *“we don’t have international business strategy at this moment, perhaps in next ten years we may develop business plan to actually expand our business operation into international markets”*

Theme 3: Strategic Partnership with Foreign Organisation(s)

Interview Question: *Does your organization have any form of partnership with a foreign organization? And why?*

In today’s business world, strategic alliance and partnership are the emerging drivers of competitiveness and globalization for numerous organisations. It is unfortunate that the medium scale construction contractors have been perceived as potential large scale construction organization in future, they are not tapping into the concepts of organizational alliance which is capable to strategically facilitate their business expansion into global construction markets. All the organisations interviewed indicated that they didn’t have any form of business alliance and partnership both locally and internationally. CC-1 *“We don’t have any strategic alliance or in partnership with any foreign organization at this moment. Our organization is very cautious in partnership or alliance because it comes with a lot of uphill tasks and it would involve an extensive feasibility study and business protocol”*. The organization CC-2 added that *“We consider our organization has not been grown big enough to strategically forming international partnership”*.

In addition, some organisations are striving to solely develop themselves into large scale construction businesses locally and nationally, as CC-3 *“Our organisation haven’t explored the possibilities and advantages for partnering with foreign organisation at this point in time. Our business intention is to strategically develop and grow our resources locally”*. However, two contractors CC-5 and CC-10 indicates that they may consider partnering with foreign organization on joint venture project within South Africa; as CC-5 said, *“Our organisation doesn’t have any foreign partnership in our business; maybe because of the opportunities*

haven't presented itself to our business landscape and we are not ready to start searching for it".

It can be said that the strategic partnership as one pillar of competitive advantage for various organizations in today's business is not being utilized or adopted by the medium construction contractors in Port Elizabeth, South Africa, both on local and global landscape of business operations. All the organisations interviewed indicated that there are not in any form of business partnership. Accordingly, the contractor CC-10 said, *"Currently our organisation is not into any form of partnership with foreign organisation as we have not look into that depth of business strategy"*. However, it is an open discussion in most of the organizations to consider it, but they have generally lack the interest to see the needs to strategically ascertain the pros and cons for engaging in it and how it would be beneficial to their business performance. Also, CC-10 further added that *"... I see businesses especially in the construction industry "big players" engage with lots of foreign organisations in their business and they are quite competitive and well off. As such, we are not entirely close-minded about it"*. Unfortunately, about 40% of the contractors interviewed considered that any form of business partnership or alliance is unnecessary as they lack interest to engage in it. CC-4 *"No, we don't have interest"* and CC-9 *"No, we don't have any partnership and we consider it not necessary for us"*.

5 Conclusion

The article set out to evaluate the globalisational readiness and competitiveness amongst the medium scale contractors in the Port Elizabeth, Eastern Cape province, South Africa. The critical review on literature has shown that African continent is attracting huge global interest in their construction market; and it is obvious that globalization is becoming one of the emerging drivers of competitiveness for various countries and organization in the construction market. As such, the globalization forces are inevitable and the local contractors in SA must consciously create higher level of readiness to strategically participate in the infrastructure development that taking-off within the continent and beyond. In this fact, the South African construction industry as one of the most structured and coordinated construction industry within the continent; should encourage its contractors especially the medium scale contractors. They should seize up the advantage of its strategic positioning within the continent to develop and adopt business strategies that would embrace its international business management approach; sustainability and competitiveness. This is possible as researcher commentators have highlighted that contracting business in Southern Africa is been dominated by South African Contractors. However, the new strategies on the increasingly penetration and domination of the Chinese, European and Indian contractors within the continent; should serve as serious wakeup call for indigenous construction organisations in Africa.

It can be said that the further persistence of lack interest and for global readiness and willingness to strategically explore global markets amongst local contractors will under-mind their sustainability and competitiveness in the nearest future. As such, the strategic readiness for the South African construction organisations should target to harness the trends of globalisation as a competitive advantage. However, strategic positioning remains the last life-belt for the continent to improve its global penetration and participation as it would enable them to weather the storms of globalisation challenges; and to harvest the benefits emanating from it. Hence, it was found that most challenging and mitigating factors for the medium contractors not be able to internationalising their businesses are lack of knowledge and awareness of opportunities on global markets; focusing only risk aspect of going globally and neglecting advantages; short-sighted on the strategic positioning on the continent; comfort zone and not willing to grow big and highly structured organisations (may lose control of the business); and lack of strategic resources and willpower to explore the global market.

Therefore, this study was based on pilot study with a small sample of contractors; the result has revealed valuable and strategic insights for raising awareness on globalisational readiness amongst contractors in the study area and South Africa generally. Thus, it can be recommended that the construction industry players and contractors should drastically develop interest in exploring and, to actively penetrate and participate in the construction global market most especially within the African continent. Because, having the ability to develop globalization business strategy amongst the construction contractors would heighten the economic sustainability and competitiveness globally. If these commendations are adhered, there will be significant improvement amongst medium contractors that would develop and grow into large scale construction business in the Port Elizabeth, Eastern Cape Province of South Africa.

6 References

- Ambastha, A., & Momaya, K. (2004). Competitiveness of Firms: Review of theory, frameworks and models. *Singapore Management Review*, 26(1), 45-61.
- Blunck, F. (2006). *What is Competitiveness*. online: <http://www.competitiveness.org/article/articleview/774/1/32/>.
- Daly, H. (1999). Commentary Globalization versus International- some implication. *Ecological Economic*, 31, 31-37.
- Depperu, D., & Cerrato, d. (2005). “*Analyzing International Competitiveness at the Firm Level: Concepts and Measures*”. Piacenza: Università Cattolica del Sacro Cuore.
- Dlungwana, W., & Rwelamila, P. (2004). Contractor Development Models that Meet the Challenges of Globalisation – A Case for Developing Management Capability of Local Contractors. In S. Ogunlana, C. Charoengam, H. Pannapa, & H. B. W. (Ed.), *International Symposium on Globalisation and Construction: CIB W107 (Construction in Developing Economies) and CIB TG23 (Culture in Construction)* (pp. 348-358). Bangkok, Thailand: CIB-SCE, AIT.
- ECORYS SCS Group. (2011). *FWC Sector Competitiveness Studies N° B1/ENTR/06/054 – Sustainable Competitiveness of the Construction Sector*. Rotterdam: European Commission.
- Ellis, J., & Williams, D. (1995). *International Business Strategy*. London: Pitman Publishing.
- Gonov, J., & Genova, J. (2001). *Globalisation, The Competitive Advantage of Nations and the Role of Culture*. Sofia: City University Seattle.
- Howes, R., & Tah, J.M.H. (2003). *Strategic Management Applied to International Construction*. London: Thomas Telford Limited
- Ibrahim, A. A. (2013). The Impact of Globalisation on Africa. *International Journal of Humanities and Social Science*, 3(15), 85-93.
- KPMG Africa Limited (2014) Sector Report: Construction in Africa [Available Online] at: <https://www.kpmg.com/Africa/en/IssuesAndInsights/Articles-Publications/General-Industries-Publications/Documents/Construction%20in%20Africa.pdf> [Accessed on 15th February 2015]
- Kumo, W.L., Omilola, B., & Minsat, A. (2015). African Economic Outlook: South Africa [Available Online] at: http://www.africaneconomicoutlook.org/fileadmin/uploads/aeo/2015/CN_data/CN_Long_EN/South_Africa_GB_2015.pdf [Accessed on 1st December 2015]
- Martin, L. (2013). Social Capital of South African Emerging Contractors - Implications on Learning. *Journal of Construction Volume 5 Number 2*, 17-25.
- Momaya, L. (1998). Evaluating International Competitiveness at the Industry Level. *Vikalpa*, 23(2), 39-46.
- National Research Council U.S. (2009). *Advancing the Competitiveness and Efficiency of the U.S. Construction Industry*. Washington: National Academy of Sciences.

- Ngowi, A. B., Pienaar, E., Talukhaba, A., & Mbachu, J. (2004). Regional Initiative as a Competing Strategy in the Global Construction Market. In S. Ogunlana, C. Charoenngam, H. Pannapa, & H. B. W. (Ed.), *International Symposium on Globalisation and Construction: CIB W107 (Construction in Developing Economies) and CIB TG23 (Culture in Construction)* (pp. 123-134). Bangkok, Thailand: CIB-SCE, AIT.
- Ofori, F. (2000). *Challenge of Construction Industries in Developing Countries: Lessons from various countries*. Department of Building, National University of Singapore.
- Orozco, F., Serpell, A., & Molenaar, K. (2011). Competitiveness factors and indexes for construction companies: findings of Chile. *Revista de la Construcción, Volumen 10 No 1*, 71-109.
- Porter, M. (1985). *Competitive Advantage: Creating and sustaining superior performance: with a new introduction*. New York: The Free Press.
- Riley, J. (2012). What do we mean by "competitiveness"? *tutor2u Resource*, 1-2.
- Tallman, S., & Fladmoe-Lindquist, K. (2002). Internationalisation, Globalisation, and Capability-Based Strategy. *California Management Review*, 45(1), 116-135.
- Wadiwalla, F. (2003). *The Evaluation of Selected Risks and Opportunities Associated with Globalisation of South African Construction Companies into Southern African*. Pretoria: University of Pretoria: Unpublished MSc Thesis in Project Management.
- World Economic Forum. (2014). *The Global Competitiveness Report 2014-2015*. Geneva: World Economic Forum.

ASSESSING THE IMPLICATIONS OF PUBLIC SECTOR PROCUREMENT ON CONSTRUCTION HEALTH AND SAFETY MANAGEMENT IN ZIMBABWE

Benviolent, Chigara; Smallwood, John

Department of Construction Management, Nelson Mandela Metropolitan University, Port Elizabeth, Eastern Cape, South Africa

Abstract

The construction industry significantly contributes to economic and social development of nations. Yet the industry also contributes extensively to fatal and non-fatal work-related accidents. Regrettably, investment decisions in the industry continue to be made with disregard of Health and Safety (H&S), and where it is given attention it is mostly too late in the project lifecycle. However, upstream decisions made at procurement stage have a considerable impact on site H&S management. This research therefore explores the level of H&S integration in public sector procurement, and its impact on construction H&S management in Zimbabwe. The primary data was collected in Harare and Bulawayo through self-administered questionnaires, and a review of public sector procurement regulations, while the secondary data was collected through a review of published literature. The results of the study show that traditional factors such as bid amount, financial status, and project delivery time are given preference ahead of H&S when procuring contractors for public sector projects. Tight budgets, late appointment of contractors, and weak contractual provisions collectively create ideal conditions for disregarding H&S at procurement. Although these results are consistent with those obtaining in other developing countries, they depict a situation in which H&S management is not holistic. A review of procurement frameworks and commitment of clients to financially support the contractor's H&S programme are expected improve the situation. The results of this study are expected to influence public procurement policy direction and the setting of priorities for action to improve construction H&S management in Zimbabwe and elsewhere.

Keywords: Health and Safety, Procurement, Public sector, Zimbabwe

1 Introduction

The construction industry significantly contributes to economic and social development of nations. Yet the industry also contributes extensively to global statistics of fatal and non-fatal work-related accidents. To demonstrate the extent of the H&S management problem, the International Labour Organisation (ILO) estimates that accidents and work-related diseases cause 2.34 million fatalities annually around the world (ILO, 2013; ILO, 2014). In the construction industry, 60 000 fatal accidents are recorded per year on construction sites worldwide (Lingard *et al.*, 2008; Phoya, 2012). In Zimbabwe, the building and construction sector has the highest rate of H&S non-compliance (Mutetwa, 2010; NSSA, 2012) and against that background; Government admits that the country is a long way from attaining the optimum level of OSH performance (NSSA, 2015).

The cost of occupational injuries is borne by employees and their families, government, and employers (ILO, 2013). The effects, which include compensation, medical expenses, lost earnings, and replacement training (ILO, 2014) play a significant role in the spread of poverty and have a negative impact on sustainable development (ILO, 2013). Globally, several response strategies have been put in place to address the H&S problem and these include, but are not limited to institutionalisation of H&S management, formulation of H&S policies, passing of legislation, and the establishment of H&S institutions. However, a major shortcoming of these interventions is their dependence on contractors to manage construction H&S. Consequently, too many workers remain exposed to an unacceptable level of hazards and risks in the industry (WHO, 2006; Abbas *et al.*, 2013). Previous studies note that contractors perceive H&S compliance as an economic burden, which severely impinges on their already slim profit margins (WHO, 2002; Agumba and Haupt, 2009), hence insufficient resource provision for H&S.

Studies pertaining to root cause analysis of accidents reveal that many on-site accidents can be attributed to professional or managerial decisions arising well before work commences on site (Lingard *et al.*, 2008; HSE, 2003). Accordingly, there is a growing trend for H&S management responsibility to be driven up the supply chain, and be partially borne by construction clients, and the designers of buildings and facilities (Lingard *et al.*, 2008). However, the fact that little has been written regarding the impact of choice of contract strategy on H&S performance indicates a major oversight in the way the issue has been dealt with thus far (Lingard and Rowlinson, 2005). McAleenan (2010) notes that H&S in construction is an integral aspect of the whole process from the time the initial thoughts are scribed down and the concept developed through to the final stages of the structure's life. A study conducted by Smallwood (1997) demonstrated that clients can positively or negatively influence H&S through pre-qualifying contractors in terms of H&S, and directly through conducting H&S audits. Therefore, integrating H&S in procurement should go a long way to improving H&S performance on construction projects. According to Harding (2014), responsible procurement should take into account not only the financial value of the contract, but also the risks of the tasks involved.

In public sector procurement, government has a leadership role to play in preventing work-related deaths and injuries by ensuring their construction projects are managed safely (Worksafe Victoria, 2010; McAleenan, 2010; ASCC, 2006; Okorie *et al.*, 2014). Public authorities can exert influence on duty holders by making improved H&S performance a condition of eligibility for them to participate in government contract / tender processes (Lingdon, 2011). Unfortunately H&S is not a priority when businesses are choosing contractors – it is overlooked altogether (Harding, 2014; Okorie *et al.*, 2014). In Botswana, Mwanaumo *et al.* (2014) note that H&S is non-existent during project planning stages, while Lingard *et al.* (2008) indicate that in the UK, client-led H&S management in the planning and procurement of construction work was not well established. In that case, Longdon (2011) implores that more could be done to embed H&S guidance among public sector clients. This research, which is part of a broad research project pertaining to integrating sustainability principles in construction H&S management, explores the level of H&S integration in public procurement, and its effects on construction H&S management within Zimbabwe's public sector construction.

2 Literature Review

Public procurement refers to the acquisition of goods and services by government or public sector organisations (Uyarra, 2014). It is one of the key economic activities of government utilised for achieving economic, social, and other objectives (Thai, 2001). The economic significance of public procurement outlays is phenomenal and is conservatively estimated as

follows: over €2 trillion in 2009 (European Union, 2011), approximately 10 % of the Korean GDP (Choi, 2010); the public sector commissions approximately 40% of total construction output in the UK each year (Longdon, 2011). The considerable size of public procurement has far-reaching implications for H&S management. Previous studies (ASCC, 2006; Worksafe Victoria, 2010; Okorie *et al.*, 2014) confirmed that the public sector as a major procurer of building and construction services, policy maker and regulator, has a direct influence on construction H&S management. According to Smallwood & Venter (2012), clients make key decisions concerning project budget, project objectives, and performance criteria and some of the objectives may create the type of pressures and constraints known to have a significant impact upon H&S during construction. The Australian Safety and Compensation Council (ASCC) (2006) and the American Industrial Hygiene Association (AIHA) (2005) note that if governments, at all levels, integrate H&S requirements into all stages of the procurement process, suppliers will need to demonstrate their ability to meet these requirements. According to Rwelamila and Smallwood (1999), incorrect choice and use of procurement systems contribute to neglect of H&S by project stakeholders. Previous studies (ASCC, 2006; Alli, 2008; Worksafe Victoria, 2010) observe that including H&S during procurement leads to improved productivity, reduced costs, better prediction and management of production and operational costs over the lifecycle of the project, and innovation in design and construction. Research further shows that the cost of investing in H&S is less than the cost of occupational hazards (cidb, 2009; Huang 2011; Emuze and Smallwood, 2012).

In spite of this evidence, Lingard *et al.* (2008) argue that constructors bear the largest portion of responsibility for construction H&S. Unfortunately, dependence on contractor-centric H&S management has not yielded the required results. The problem is further compounded by lack of government commitment (Mwanaumo *et al.*, 2014; Mwombeki, 2006 in Chiocha *et al.*, 2011), bribery, corruption and political interference (cidb, 2011; Okorie *et al.*, 2014). In the UK, Crosthwaite (2007) reports that public sector clients still have a relatively narrow view of their involvement in project H&S. A study by Gibb & Bust (2006) involving five African countries (Botswana, Egypt, Malawi, Nigeria, and South Africa) noted that clients are not supportive of H&S initiatives. In Botswana, Mwanaumo *et al.* (2014) point out that H&S within the contract is not even a point of discussion for inclusion at the planning stage.

2.1 Procurement Method

The client's selection of project procurement method is particularly important because this dictates when and how other key project stakeholders will be engaged to advise on H&S in the project (Lingard *et al.*, 2008). The two primary methods of contracting are single prime contract (the design-bid-build model) also known as traditional contracting and design-build construction (AIHA, 2005). The traditional method is characterised by the separation of design and construction processes. However, the high level of differentiation and specialisation associated with the traditional approach leads to a situation where H&S is not considered during the early phases of the project (Lingard and Rowlinson, 2005). However, to counter this problem, clients can prequalify and select only those contractors who are fully qualified by virtue of their H&S programs and performance (Huang, 2011; Blarke, 2013; Lingard *et al.*, 2008). On the other hand, the design-build method is a unitary approach characterised by single-point responsibility offered to the client by the contractor, and the opportunity for overlapping the design and construction phases (Lingard and Rowlinson, 2005). Design-build projects go under many names; for example, design-build, design and build, design manage construct, design and manage, build operate transfer (BOT), build own operate transfer (BOOT), build own operate (BOO), or turnkey. By adopting single-point responsibility, the management of H&S should be more readily possible in design-build than with other contract strategies (Lingard and Rowlinson, 2005).

2.2 Contractor Selection Criteria

Contractor selection is a critical activity that plays a vital role in the overall success of any construction project (Palaneeswaran and Kumaraswamy, 2001). Among all factors that may affect the selection of a contractor, cost or price consideration has for a long time been the main evaluation factor (Huang, 2011). Although the public sector has a long history of using the lowest bid as the award criterion for contracts, reliance on non-price criteria is increasing (Waara and Bröchner, 2006; Lorentziadis, 2010) and the best or most economically advantageous tender is becoming a widespread approach for contractor selection. For instance, Bergman and Lundberg (2013) note that in the EU, lowest price is used less frequently, and instead, supplier selection methods that combine price and quality into a total score are used more often (Ballestros-Perez, 2015). Apart from enhancing H&S through the use of multi-criteria weighting of different variables, it also enhances the integrity of the evaluation process and to reduce the risk of unfair bias or corruption (Lorentziadis, 2010; Bergman and Lundberg, 2013). A diversity of factors are used to evaluate contractors and these include quality, technical merit, aesthetic, delivery date and delivery period, or period of completion and such additional criteria including safety, durability, security, and maintenance (Zedan and Skirtmore, 1997; European Union, 2004) and functional characteristics, environmental characteristics, running costs, cost effectiveness, safety, after sales service and technical assistance (European Union, 2004); contractors' current work load, contractors' past experience in terms of size of projects completed, contractor's management resources, time of the year (weather) and contractors' past experience in terms of catchment, i.e. national or local (Holt *et al.*, 1994); technical expertise, and cost (Watt *et al.*, 2010); the bid amount; time of execution, and quality of previous work (Herbsman, 1992 cited in Zedan & Skirtmore, 1997). Nonetheless, H&S features less frequently among the aforementioned criteria signifying that little consideration is given to it during contractor procurement. However, the selection criteria in public sector procurement is sometimes circumvented due to corruption (cidb, 2011; Okorie *et al.*, 2014) and other unethical behaviour by public officials leading to the award of contracts to contractors with poor H&S records (Okorie *et al.*, 2014).

3 Research Methodology

The study used an exploratory design due to a dearth of Zimbabwean literature pertaining to this subject. An exploratory design explores the possibility of obtaining as many relationships as possible between different variables (Panneerslvam, 2004) and is particularly suitable for subject areas where there is little experience to serve as a guide (Kothari, 2004). The primary data was collected through questionnaire surveys, and interviews. Purposive sampling was used to select survey respondents. According to Leedy and Ormrod (2013), in purposive sampling, people or other units are chosen, as the name implies, for a particular purpose. Thirty (30) semi-structured questionnaires, developed based on a review of previous work by Huang (2003), ASCC (2006), Worksafe Victoria (2010), and Langdon (2011), were administered to members of the procurement technical committee within government departments, statutory agencies, and local authorities in Harare and Bulawayo. In addition to questionnaires, 5 follow-up interviews were also conducted. In a related study in Malawi, Chiocha *et al.* (2011) distributed 30 questionnaires and 21 responses were received and analysed. In spite of the small sample, the results of the survey can still provide a valuable purpose and provide enlightenment for follow-up research (Huang, 2003). A sample size of 30 items is often adequate (The Economist, 2003). According to Chan *et al.* (2001) cited by Priyadarshani *et al.* (2013) the sample or group size could be from 10 to 50 participants. Qualitative and quantitative procedures were employed for data analysis. Quantitative analysis was done using the Statistical Package for Social Scientists (SPSS) version 21 and Microsoft Excel, while content analysis was used for the interpretation of the qualitative data.

4 Findings and Discussion

4.1 Demographics of the Respondents

A total of 20 questionnaires, representing a 67% response rate, were successfully completed and analysed. The completed questionnaires were received from central government departments (50%); quasi government (45%) and local authorities (5%). The respondents were distributed as follows: Directors (25%), Deputy Directors (10%), Chief Quantity Surveyors (10%), Engineers (30%), Admin Officers (15%), Safety Officers (5%), and Accountants (5%). The respondents' work experience spanned from 4 to 30 years and the mean work experience is 14.05 years. The qualifications of respondents are as follows: Master's Degree (35%), Honours Degree (50%), Higher National Diploma (10%), and National Diploma (5%). It is evident from this demographic analysis that the respondents were highly experienced and qualified to provide valid and reliable assessments of issues raised in questionnaires and interviews.

4.2 Public Procurement Regulations in Zimbabwe

Public sector procurement is governed through the Procurement Act (Chapter 22:14) and its subsidiary regulations, Statutory Instrument (SI) 126 of 2015 Procurement (Amendment) Regulations. The Procurement Act is modelled along the United Nations Commission on International Trade Law (UNCITRAL) Model Law on Public Procurement. UNCITRAL Model Law is premised on achieving competition, transparency, fairness, economy and efficiency in the procurement process (UN, 2014). These values are also enshrined in the Constitution of Zimbabwe and the Procurement Act which requires that public funds are expended transparently, prudently, economically and effectively. The Procurement Act mandates procuring entities (ministry, department or other division of the Government; or statutory body that engages in procurement; or any local authority) to procure goods, construction works and services for the state, statutory bodies, and other persons, with the supervision of the State Procurement Board (SPB). Prior to the promulgation of SI 126 of 2015, the SPB would procure, on behalf of procuring entities, construction works of a value exceeding \$2million. Although the Act defines multi-criteria to evaluate tenders, the criteria are, however, 'devoid' of H&S aspects. Reference to H&S is implied through section 34(1) (d) which requires suppliers to have paid all taxes, duties, and rates for which they are liable in Zimbabwe, together with any contributions or payments due under the National Social Security Authority Act. This is, however, inconsistent with the Constitution which 'treats' H&S as a fundamental workers' right wherein every employee is entitled to just, equitable and satisfactory conditions of work.

4.3 H&S Considerations at Contractor Procurement

Table 1 shows the respondents' degree of concurrence relative to selected procurement issues and their impact on H&S management in terms of responses to a scale of 1 (strongly agree) to 5 (strongly disagree), and a mean score (MS) ranging between 1.00 and 5.00 and the midpoint score of 3.00. The results show that 6 out of 11 aspects have a MS ≥ 3.00 which indicates that respondents can be deemed to agree with a majority of the statements.

Table 1: Degree of concurrence with H&S related procurement statements

Statement	Response (%)						MS
	Unsure	Strongly Disagree (1).....Strongly Agree (5)					
		1	2	3	4	5	
Considering H&S at procurement stage lead to reduced work-related accidents and diseases	0.0	0.0	5.0	0.0	30.0	65.0	4.55
The Procurement Act is silent on the need to consider H&S when procuring projects	17.6	5.9	5.9	23.5	41.2	5.9	2.82
Conditions of contract for public sector projects are silent on matters of H&S	10.5	21.1	21.1	5.3	42.1	0.0	2.47
Competitive nature of bidding for public sector projects forbid contractors to sufficiently provide for H&S in their tender	5.0	10.0	25.0	10.0	40.0	10.0	3.00
Public sector projects consider issues of H&S mainly at project implementation stage	5.0	5.0	15.0	10.0	50.0	15.0	3.40
Procurement officers lack requisite skills to evaluate tenders for construction H&S	10.5	15.8	10.5	21.1	36.8	5.3	2.74
Tight budgetary constraints contribute to non-considering of H&S by Procurement entities	0.0	5.0	10.0	10.0	60.0	15.0	3.70
Late appointment of contractors in the procurement process contributes to poor H&S performance during project execution	5.0	5.0	20.0	15.0	35.0	20.0	3.30
Tender documentation and processes provide for assessments at tender/contract award stage of contractors' proposals and potential performance with respect to H&S	10.0	5.0	40.0	15.0	25.0	5.0	2.55
H&S related information or risks are given to prospective bidding contractors	5.3	10.5	47.4	15.8	15.8	5.3	2.42
Construction H&S laws in Zimbabwe provide for minimal H&S provisions	5.3	5.3	21.1	15.8	42.1	10.5	3.16

The results from Table 1 reveal that consideration of H&S during contractor procurement can positively contribute to reducing work-related accidents and diseases. This variable has MS 4.55. A $MS > 4.20 \leq 5.00$ equates to between agree to strongly agree / strongly agree. This result corroborates the contention of Cameroon *et al.* (2005) who concluded that effective planning for H&S is essential if projects are to be delivered without experiencing accidents or the health of site personnel.

The research also reveals that respondents perceive that certain procurement related practices may contribute to poor H&S management and these are discussed below.

- Tight budgetary constraints (MS 3.70). When $MS > 3.40 \leq 4.20$ it indicates that the interventions can be deemed to be taken between neutral and agree / agree. The majority of respondents (75%) perceive that budget constraints bedevil the public sector as a result of a non-performing economy, which contributes to non-consideration of H&S by public procurement entities;
- Late appointment of contractors (MS 3.40). In 58.8% of selected cases projects completed within the last five years, respondents indicate that contractors were procured at tender stage. Although this finding is consistent with the traditional procurement approach used on 78% of the selected projects, however, the stage of

contractor procurement is probably too late to take advantage of contractors' expertise (in terms of buildability and health and safety issues) (Longdon, 2011);

- Consideration of H&S during project implementation stage (MS 3.40). Respondents perceive that H&S is mainly considered during the construction phase of the project. This approach 'exports' H&S responsibility to the contractor. The results are, however, consistent with earlier findings (Lingard *et al.*, 2008) that the constructor bears the largest portion for responsibility for construction H&S. Nevertheless, it is at variance with several studies (AIHA, 2005; ASCC, 2006) who argue that if government at all levels, integrate H&S in all stages of the procurement process, suppliers will demonstrate the ability to meet these requirements, and
- Minimal provisions for H&S in Construction Regulations (MS 3.16). This finding reveals that respondents perceive that H&S issues are not sufficiently incorporated in construction regulations. Respondents also perceive that tender documentation and processes do not provide for assessments at tender / contract award stage of contractors' proposals and potential performance with respect to H&S.

The remaining aspects have $MS > 2.40 \leq 3.00$ which can be deemed to be taken between disagree to neutral / neutral. For instance, the effect of competitive bidding on H&S is rated at the midpoint (MS 3.00). On the other hand, respondents do not agree with statements that: procurement laws (MS 2.82) and conditions of contract (MS 2.47) for public sector projects are silent on H&S issues; procurement officers lack requisite skills to evaluate tenders for construction H&S (2.74); and H&S related information or risks are given to prospective bidding contractors (2.42).

4.4 Criteria for Selecting Contractors

The study noted that clients consider a number of factors when procuring contractors and these are presented on Table 2. The results show, in descending order, that traditional evaluation factors such as cost (bid amount), financial standing, project delivery time, and technical expertise and experience, are important when procuring contractors on public sector construction works because their MS are greater than the median value 3.00. However, H&S considerations, environmental considerations and quality fall below the median value 3.00 meaning that they are less important when procuring contractors for public sector projects. This finding concurs with conclusions of previous studies where the 'need for cost certainty' was the highest ranked criteria (Longdon, 2011) while the requirement to manage H&S is not a priority when choosing contractors (Longdon, 2011; Harding, 2014; Okorie *et al.*, 2014; Mwanaumo *et al.*, 2014).

Table 2: Criteria for procuring contractors

Criterion	MS	Rank
Cost (bid amount)	3.69	1
Financial standing	3.56	3
Time of execution	3.38	3
Technical expertise & experience	3.31	2
Quality	2.88	5
Environmental considerations	2.31	6
Health and Safety (H&S) record	1.94	7
Others (e.g. previous litigation & company requirements)	0.44	8

5 Conclusion and Further Research

Public sector procurement has the potential to influence construction H&S management. However, due to a number of factors, clients do not seem to emphasise H&S at this stage. This research determined that clients know that inclusion of H&S at procurement stage has a momentous impact on improving H&S performance on their projects. However, tight budgets, the competitive nature of procurement, late appointment of contractors, and weak contractual provisions provide ideal conditions for disregarding H&S during upstream decision making. Consequently, H&S aspects are left until project implementation stage. Accordingly, economically advantageous contractors who do not systematically manage H&S risks may be appointed at the expense of workers' H&S. The research therefore recommends a review of the procurement processes and frameworks to allow for participation on public projects of contractors and other stakeholders who are committed to improving the H&S of their workers and the public. On the same note, clients have an obligation to financially support contractors' H&S programmes, and partake in project H&S activities, and to engage stakeholders who can effectively manage H&S. Moreover public sector procurement provides an opportunity for governments and their agencies to raise the bar for construction H&S. This research provided exploratory evidence based on public sector procurement, and further research can include the private sector and other stakeholders such as contractors, and consultants. In addition, an empirical study can also address the relationships between public procurement and accident trends based on case study projects.

6 Acknowledgement

The researchers are grateful to all procurement entities that completed the questionnaire and those who participated in the interviews.

7 References

- Abbas, R.A., Zalat, M.M. & Ghareeb, N.S.E., (2013). Non-fatal occupational injuries and safety culture: A cross sectional study of building workers in Mit-Ghamr City, Dakahlia, Egypt. *Open Journal of Safety Science and Technology*, 3(4), pp. 69-79.
- Agumba, J.N. & Haupt, T.C., (2009). Construction health and safety culture in South African small and medium enterprises. *4th Built Environment Conference*, Livingstone, Zambia, 17-19 May, 2009, 460-472. Cape Town: Association of Schools of Construction of Southern Africa.
- Alli, B.O., (2008). *Fundamental principles of occupational health and safety*. 2nd ed. Geneva: International Labour Office.
- American Industrial Hygiene Association (2005). *Health and safety requirements in construction contract documents*. USA: American Industrial Hygiene Association.
- Australian Safety and Compensation Council (2006). *Guidance on occupational health and safety in government procurement*. Commonwealth Australia.
- Ballestros-Perez, P., Skikmore, M., Pellicer, E. and Gonzalez-Cruz, M.C. (2015). Scoring Rules and abnormally low bids criteria in construction tenders: a taxonomic review. *Construction Management and Economics*, 33(4), pp. 259-278.
- Bergman, M.A. and Lundberg, S. (2013). Tender evaluation and supplier selection methods in public procurement. *Journal of Purchasing and Supply*, 19, pp. 73-83.
- Blarke, P. (2013). Health and safety as a key factor in winning contracts. Kazakhstan: Turner & Townsend. Available on: www.turnerandtownsend.com (20 December 2015).
- Chiocha, C., Smallwood, J. and Emuze, F. (2011). Health and safety in the Malawian construction industry. *Acta Structilia*, 18(1), pp. 68-80.

- Choi, J. (2010). A study of the role of public procurement – can public procurement make society better? In: *Proceedings 4th International Public Procurement Conference* in South Korea, 26-28 August, Seoul, South Korea.
- cidb (2009). *Construction health and safety in South Africa: Status and Recommendations*. Pretoria: cidb.
- cidb (2011). *Construction quality in South Africa: A client perspective*. Pretoria: cidb
- Durdyev, S. and Mbachu, J. (2011). On-site labour productivity of New Zealand construction industry: Key constraints and improvement measures’, *Australasian Journal of Construction Economics and Building*, 11(3), pp. 18-33.
- Gibb, A. & Bust, P. (2006). *Construction health and safety in developing countries*. Loughborough: European Construction Institute.
- Harding, T. (2014). Procurement and health and safety: has health and safety been forgotten in all the bureaucracy. *Public Services Group and Yorkshire Branch Joint Networking Event*, 24 January. IOSH.
- Holt, G.D., Olomolaiye, P.O. and Harris, F.C. (1994). Factors influencing U.K. construction clients’ choice of contractor. *Building and Environment*, 29(2), pp. 241-248.
- HSE, (2003). *Causal factors in construction accidents*. London: HSE.
- Huang, X. (2003). *Owners’ role in construction safety*. Unpublished. PhD Thesis. University of Florida. Available on: [etd.fcla.edu>UFE0001376>huang_x](http://etd.fcla.edu/UFE0001376/huang_x) (accessed 12 December 2015).
- Huang, X. (2011). An Analysis of the Selection of Project Contractor in the Construction Management Process. *International Journal of Business and Management*, 6(3), pp. 184-189.
- ILO (2013). *Hopes and challenges in developing countries. EU-ILO joint project “improving safety and health at work through A Decent Work Agenda*. Geneva: ILO.
- ILO (2014). *Safety and health at work: a vision for sustainable prevention. XX World Congress on Safety and Health at Work 2014*. Global Forum for Prevention, 24-27 August, Frankfurt, German. Geneva: ILO.
- Kothari, C.R. 2004. *Research Methodology: Methods and Techniques*, 2nd ed., New Dehli: New Age Techno Press.
- Langdon, D. (2011). *Health and safety in public sector construction procurement. A follow up study*. London: HSE.
- Leedy, P.D. and Ormord, J.E. (2013). *Practical Research. Planning and Design*. 10th ed. Boston: Pearson.
- Lingard, H. and Rowlinson, S. (2005). *Occupational health and safety in construction project management*. Canada: Spon Press.
- Lingard, H., Blismas, N., Wakefield, R., Jellie, D. and Fleming, T. (2008) ‘Safer construction’: the development of a guide to best practice. In: *Proceedings Third International Conference of the Cooperative Research Centre (CRC) for Construction Innovation*, 12-14 March, 2008, Gold Coast, Australia.
- Lorentziadis, P.L. (2010). Post-objective determination of weights of the evaluation factors in public procurement tenders. *European Journal of Operational Research*. January 2010, 200(1), pp. 261-267.
- McAleenan, P. (2010). Assessing safety issues in construction. In: McAleenan, C. & Oloke, D. (Eds). *ICE manual of health and safety in construction*. London: Thomas Telford, pp. 101-110.
- Mwanaumo, E., Thwala, W.D. and Pretorius, J. (2014). Assessing health and safety requirements in construction contracts in Botswana. *Journal of Economics and Behavioral Sciences*, 6(1), pp. 37-43.

- NSSA, (2015). Economy needs to embrace occupational safety and health (OSH) culture. *Financial Gazette*, 15 October.
- Okorie, V., Emuze, F., Smallwood, J. & van Wyk, J. (2014). The influence of clients' leadership in relation to construction health and safety in South Africa. *Acta Structilia* 21(2), pp. 44-68.
- Palaneeswaran, E. and Kumaraswamy, M. (2001). Recent advances and proposed improvements in contractor prequalification methodologies. *Building and Environment*, 36 (1), pp. 73-87.
- Panneerslvam, R. (2004). *Research Methodology*. New Dehli: Prentice Hall.
- Priyadarshani, K., Karunasena, G. and Jayasuriya, S. (2013). Construction safety assessment framework for developing countries: A case study of Sri Lanka. *Journal of Construction in Developing Countries*, 18(1), pp. 33-51.
- Procurement (Amendment) Regulations 2015 (SI 2015/126). Harare: Government of Zimbabwe.
- Procurement Act 2001, Chapter 22:14. Harare: Government of Zimbabwe.
- Rwelamila P.D. and Smallwood, J.J. (1999). Appropriate procurement systems for hybrid TQM. In: Singh, A., Hinze, J.W. and Coble, R.J. (eds) In: *Proceedings of CIB W99 International Conference Implementation of Safety and Safety on Construction Sites, Honolulu, Hawaii, 24-27 March 1999*, pp. 87-94.
- Smallwood, J.J. (1997) Client influence on contractor health and safety in South African construction. *Proceedings of the 1st International Conference of CIB W99: Current and Future Challenges*, Cape Town, October 1997. pp. 95-104.
- Smallwood, J.J. and Venter, D. (2012). The Influence of Project Managers on Construction Health and Safety in South Africa. *Construction Economics and Building*, 2(1), pp.
- Thai, K.V. (2001). Public procurement re-examined. *Journal of Public Procurement*, 1 (1), pp. 9-50.
- The Economist, (2003). *Numbers guide: The essentials of business numeracy*. 5th ed. London: The Economist.
- United Nations, (2014). *UNCITRAL Model Law on Public Procurement*. New York: United Nations
- Uyarra, E., Edler, J., Garcia-Estevéz, J., Georghiou, L. and Yeowa, J. (2014). Barriers to innovation through public procurement: A supplier perspective. *Technovation*, 34, pp. 631–645.
- Waara, F. and Bröchner, J. (2006). Price and nonprice criteria for contractor selection. *Journal of Construction Engineering and Management*, 132(8), pp. 797-804.
- Watt, D.J., Kayis, B. and Willey, K. (2010). The relative importance of tender evaluation and contractor selection criteria. *International Journal of Project Management*, 28(1), pp. 51-60. January.
- Worksafe Victoria (2010). *Handbook for the public sector. Health and safety in construction procurement*. Edition number 1, Australia: Worksafe Victoria.
- World Health Organisation (WHO), 2002. *Good practice in occupational health services: a contribution to workplace health*. Copenhagen: WHO.
- Zedan, H. and Skirtmore, M.R. (1997). Criteria for contractor selection. *Construction Management and Economics*, 15(1), pp. 19-38.

FRAMEWORK FOR CONTRACTORS’ BID SUCCESS IN NIGERIA: SWOT APPROACH

Fawale, Tolulope Samuel

Department of Quantity Surveying, Faculty of Environmental Sciences, University of Benin, Benin City, Edo State, Nigeria

Dada, Joshua Oluwasuji

Department of Quantity Surveying, Faculty of Environmental Design and Management, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria

Abstract

Models concerning bid/no bid decision have been worked upon by different types of researchers. However, to maintain fee schedules at a level that will assist contractors run a profitable and high quality business that best serves the need of clients who rely on their products and services, successful bids are required. Therefore, building contractors need to consider both internal (strengths and opportunities) and external (weaknesses and threats) factors necessary to develop a framework for successful bids. SWOT tool is considered as a structured approach that could help management to systematically analyze issues that may affect the fulfilment of their goals and objectives. An examination of the factors influencing contractors’ bidding activities in Nigeria was considered with a view to developing a framework that could enhance bid success. One hundred and seventy-one useable responses were retrieved through questionnaire administration on randomly selected building contractors. The responses were used to elicit information on the factors identified, and were later classified into internal and external factors using SWOT tool as a structured approach to contractors’ bid success. The classification identified availability of equipment and materials, size of contract, strength of the firm in the industry - internal factors; while government policy, tax liability, timing requirement - external factors. The study concluded that building contractors in Nigeria must always conduct initial project research and embark on evaluation processes during bidding activities, and base on SWOT tool come up with an approach for a successful bid before committing much resource on the project.

Keywords: Bid success, Contractors, Framework, Nigeria, SWOT

1 Introduction

Bidding is a method used for procuring major construction projects such as building and infrastructures in the construction industry. Public sector bidding therefore guarantees transparency, publicity and equal opportunity to all bidders as it reduces the risk of bias and corruption (Auriol, 2006; Celentani *et al.*, 2002). The search for a competitive advantage is an idea that is much sought for by contractors in the construction industry (Tan *et al.*, 2008). The construction industry is one of the largest job creators in developing countries and has become highly competitive with the advent of globalization (Garbharran, *et al.*, 2012; Nguyen *et al.*, 2004). The construction industry in Nigeria has grown tremendously over the years and it has become a multi-billion naira business (Olatunji, 2011). It is an industry that is rich enough to drive the economy of the country.

In the construction industry, projects are usually awarded through bidding process and the goal of contractor's is to be successful by winning a bid award. Tan *et al.* (2008) asserts that, being involved in bids help maintain fee schedules at a level that will support and ultimately assist in running a profitable and high quality business that best serves the need of clients who rely on the contractor's products and services. Hoffmann (2000) confirms that the fundamental basis of long-run success of bids by construction firms is the achievement and maintaining of a sustainable competitive advantage. By knowing the intense nature of competitors, construction firms would be more creative and environment conscious in their strategic planning than just lowering price. This study therefore aims at identifying factors influencing contractors' bid activities in Southwest, Nigeria, with a view to developing a framework that could enhance bid success.

2 Contractors' Bid Success/SWOT Approach

2.1 Bid Success

The variations in contractors' bids are expressed as a function of time relative to winning a bid, which carries implications for capacity level of a construction firm (Bee *et al.*, 2012). It is important for contractors to strike a balance between a bid price and bid success, as bidders would always bid low. Bidding low at the expense of the actual profit to be accrued into the contractors' organization makes them less competitive in the construction market. Bee *et al.* (2012) posits that bidders in general bid low for time periods before a winning bid and they are less competitive in time periods after a winning bid.

However, by considering the individual bidders' characteristics that relate to differences in bidding competitiveness, it is shown that there is remarkable heterogeneity among the bidders in bid pricing decision for pre and post winning periods. Nevertheless, the statistically significant bidding trends before and after a winning bid strengthen the notion that systematic changes in bidding behaviour over time in reality in responses to changes in firm capacity level. These changes in capacity level therefore brought to the fore the reason for SWOT analysis to be employed in order to classify and identify internal (strengths and opportunities) and external (weaknesses and threats) factors necessary for recording success in bids.

2.2 Factors Influencing Contractors' Bid Success

Contractors need to understand their specific resources that generate competitive advantage and accordingly develop strategies to win contracts (Tan *et al.*, 2010). Improving the construction industry's competitiveness according to Green *et al.* (2008) has long been of interest to the international construction management research community. Egemen *et al.* (2007) investigated a framework for contractors to reach strategically correct bid/no bid and mark-up size decisions. The study identified the key determining factors and their importance weights by presenting survey findings of eighty (80) contracting organizations from Northern Cyprus and Turkish construction markets. Among these factors are; current workload, need for work, contractor involvement in the design phase, availability of cash to carry out the work, availability of skilled workers, availability of qualified site management staff, size of head office overhead, government policy, tax liability, availability of reliable subcontractors, reliability of company pricing, portion of nominated subcontract, portion of domestic subcontract, overall economy (availability of work), timing requirement, past experience in managing similar project, availability of labour, availability of equipment, quality of available labour, risk of fluctuation in labour prices, risk of fluctuation in material prices, availability of other projects for tendering (Bagies *et al.*, 2006; Ling *et al.*, 2005).

2.3 SWOT Analysis

SWOT is an acronym for Strengths, Weaknesses, Opportunities and Threats. It is a device that helps business managers evaluate the strengths, weaknesses, opportunities and threats involved in any business enterprise, including construction activities (Ahmad *et al.*, 2011). SWOT analysis can help construction firms gain insights into the past and think of possible solutions to existing or potential problems, either for an existing business or for a new venture (USDA, 2008; Nouri *et al.*, 2008). SWOT is a basic and candid model that assesses what a business can and cannot do, as well as its potential opportunities and threats. The method of SWOT analysis is to take the information from an environmental analysis and separate it into internal (strengths and weaknesses) and external issues (opportunities and threats). Once this is completed, SWOT analysis determines what may assist the firm in accomplishing its objectives, and what obstacles must be overcome or minimized to achieve the desired results (Singh, 2010).

SWOT analysis has been in use since the 1960s as a tool to assist strategic planning in various types of enterprises including those in the construction industry (Lu, 2010). It has its origins in the 1960s (Learned *et al.*, 1965), and was popularized by Wehrich's (1982) work. It is commonly adopted for the analysis of internal and external situations, in turn encouraging the development of strategies which can cope with these situations. The usage of SWOT analysis has been reported in many fields including that of the construction sector. For example, Shen *et al.* (2006) use the tool to analyze the situations for foreign-invested construction enterprises in China. Lu *et al.* (2009) used it in relation to Chinese construction companies in the international construction market.

Ayub *et al.* (2013) explained that SWOT helps in identifying organization's potential strengths and utilizing those in exploiting opportunities and counteracting threats; and identifying weaknesses in order to diminish them. Hence, SWOT analysis is considered as a structured approach that helps management to systematically analyze the issues that may affect the fulfilment of their vision, mission, goals and objectives. In other words, SWOT analysis is a convenient and concise way of evaluating the past, present and the future in order to make best use of data in utilizing opportunities, linking those with organization's strengths, identifying major threats, and minimizing weaknesses.

Lu (2010) in a critical review believe that SWOT is a widely used tool for analyzing internal and external environments in order to attain a systematic understanding of a strategic management situation. In turn, it encourages contractors to adopt a strategy that can best cope with the situation. The philosophy behind the SWOT analysis is that the strategies an organization adopts should match the environmental threats and opportunities with the organization's weaknesses and especially its strengths.

3 Research Methodology

Being a descriptive and quantitative study, the survey method was used to gather primary data. The scope of the study was confined to public sector projects alone and the target population were building contractors registered with the Bureau of Public Procurement. The investigation was therefore limited to the building contractors in categories A, B and C according to BPP registers. These categories were purposively considered due to the kind of projects they are eligible to bid for and manage in the construction industry. For the purpose of this study, population details of active contractors from each category were obtained, indicating 60, 82 and 95 contractors for categories A, B and C respectively. Since the population size was relatively small, questionnaire was administered and data was collected from every member of the population. The response rate constitutes 42 (70%), 61 (72%) and 68 (74%) contractors in categories A, B and C respectively.

The questionnaire was divided into two sections. Section one comprises of the background information relating to the respondents and their respective firms while the second section seeks to identify the factors in relation to the SWOT required by building construction firms for success in their bidding activities. Using SWOT analysis technique, these factors were classified into their different categories (internal and external factors). The questionnaire preparation comprised of closed-ended questions using a five point likert scale (extremely important-5 and not important-1). Closed ended questions were preferred in order to reduce the level of bias and to facilitate coding (Akintoye and Main, 2007), considering the fact that construction professionals are often too busy to attend to academic works. Data retrieved were analyzed using frequency tables, percentages and weighting values.

4 Findings and Discussion

4.1 Background Information of the Respondents

Results shown in Table 1 revealed that, more than 90% of the respondents for categories A, B and C are male (91%, 98% and 99% respectively). This is an indication that males are more dominant in the construction industry when compared to their female colleagues. Likewise, majority of the respondents were found within the age range 20-39, with 64% in category A and 75% and 87% in categories B and C respectively. Implication is that, respondents within this age group have a minimum of twenty years to be involved in public sector projects, thereby becoming experts in bidding for building construction projects. This was further highlighted by the result on the years of experience in the industry. More than 70% of the respondents have between five to ten years of experience. This indicates that their knowledge on bidding is limited, and cannot compete favourably with individuals who have more than ten years of experience on the subject of bidding. Further results show that the respondents are practicing professionals in the construction industry, majority of whom are builders and engineers, with 38%, 46% and 57% found in categories A, B and C respectively. In addition, results in category A also revealed that 21% and 29 % of the respondents are architects and quantity surveyors respectively. Quantity surveyors are referred to as project cost estimators; therefore, their services are very important during bidding process.

Table 1. Background details of respondents

Respondents	Category A (N=42)	Category B (N=61)	Category C (N=68)
<i>Gender</i>			
Male	90.5	98.4	98.5
Female	9.5	1.6	1.5
Total	100.0	100.0	100.0
<i>Age</i>			
20-39	64.3	75.4	86.8
40-59	31.0	24.6	13.2
60 & above	4.7	0	0
Total	100.0	100.0	100.0
<i>Years of experience in the industry</i>			
Less than 5 years	0	0	10.3
5 – 10 years	71.4	83.6	77.9
Above 10 years	28.6	16.4	11.8
Total	100.0	100.0	100.0
<i>Professionals</i>			
Architects	21.4	8.2	0
Builders	38.1	45.9	36.8
Engineers	11.9	26.2	57.4
Quantity Surveyors	28.6	19.7	5.8
Total	100.0	100.0	100.0

4.2 Factors base on SWOT Approach

This section describes the respondent’s opinion on the factors itemized in relation to the SWOT aspect of their organization. The items were categorized into internal factors (strengths and weaknesses) and external factors (opportunities and threats).

4.2.1 Internal factors (strengths)

Table 2 shows the overall major strengths factors ranked in order of importance as considered by the respondents. Relationship with owners was ranked first with an average weight of 0.767. This is an indication that building contractors generally place much emphasis on relationship which was considered as an area of strength in their organisation. Other factors ranked according to their order of strengths include availability of cash to carry out the work, availability of skilled workers, availability of reliable subcontractors, availability of site management staff, availability of equipment and materials among others. In order for contractors to gain entry to an approved standing list of the clients, Merna *et al.* (1990) opined meeting up with the requirement of financial stability, managerial capability, organizational structure, technical expertise and the previous record of comparable construction.

Table 2. Strength related factors

	Internal factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
	Relationship with owner	0.922	0.713	0.666	0.767	1
	Availability of cash to carry out the work	0.812	0.802	0.672	0.762	2
	Availability of skilled workers	0.771	0.879	0.556	0.735	3
Strengths	Availability of reliable of subcontractors	0.846	0.650	0.695	0.730	4
	Availability of site management staff	0.802	0.668	0.663	0.711	5
	Availability of equipment and materials	0.879	0.571	0.531	0.660	6
	Past experience in managing similar projects	0.760	0.650	0.557	0.656	7
	Strength of business partners	0.802	0.518	0.580	0.633	8

4.2.2 External factors (opportunities)

Results from Table 3 shows that majority of the contractors capitalise majorly on their strength in the industry which gives them an opportunity of landing projects when bidding. Degree of buildability was also captured among the SWOT as an opportunity to the contractor when bidding for projects. This is as a result of clear design and specifications provided by the design team for the project. Size of the contract has also been harnessed by contractors as an opportunity when bidding for public works.

Table 3. Opportunities related factors

	External factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
	Strength in the industry	0.802	0.731	0.571	0.701	1
	Degree of buildability	0.663	0.760	0.663	0.695	2
	Size of contract	0.838	0.665	0.558	0.687	3
Opportunities	Completeness of drawings and specifications	0.879	0.553	0.580	0.670	4
	Degree of technological difficulty	0.760	0.700	0.518	0.659	5
	Nature of the project	0.879	0.556	0.502	0.646	6
	Market condition	0.719	0.583	0.624	0.642	7
	Government policy	0.760	0.559	0.538	0.619	8

4.2.3 Internal factors (weaknesses)

Table 4 is a reflection of the weaknesses level of construction firms. Past experience in managing similar projects, relationship with owner, availability of equipment and materials, strength in the industry and degree of buildability were identified by the respondents as top weaknesses required in achieving bid success.

Table 4. Weaknesses related factors

Internal factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
Past experience in managing similar projects	0.724	0.663	0.624	0.670	1
Relationship with owner	0.650	0.580	0.719	0.650	2
Weaknesses					
Availability of equipment and materials	0.879	0.500	0.556	0.645	3
Strength in the industry	0.670	0.518	0.602	0.597	4
Degree of buildability	0.760	0.518	0.500	0.593	5

4.2.4 External factors (threats)

Results from Table 5 shows that government policy, tax liability, timing requirement and market conditions pose a big threat on building contractors and their success when bidding for public works. Government policies and regulations are very rigid external factors which influences the construction industry of any country (Wijewardana *et al.*, 2013). Inability of contractors to fulfil their responsibility by paying their tax will deny them the opportunity of bidding for public works. This is a major threat on the part of the contractors.

Table 5. Threats related factors

External factors	Category A (weight)	Category B (weight)	Category C (weight)	Average Weight	Rank
Government policy	0.700	0.879	0.623	0.734	1
Threats					
Tax liability	0.724	0.879	0.556	0.720	2
Timing requirement	0.667	0.587	0.719	0.658	3
Market condition	0.737	0.558	0.663	0.653	4

5 Framework

Highlight of the SWOT factors that make up the framework for contractors' bid success is shown in Figure 1. Factors found important and benefiting to the contracting firms' in the realization of their goals and objectives as they bid for success includes relationship with owner, availability of cash to carry out the work, availability of equipment and materials, size of contract, strength of the firm in the industry and degree of buildability of the work. These among others has opined by Merna *et al.* (1990) will give entry to the contractor to be included among the standing list of contractors with the client capable of executing work with them. However, some factors will limit a contractor's entry to the standing list. These among others includes past experience with managing similar projects, relationship with the owner, availability of equipment and materials, strength in the industry, government policy, tax liability, timing requirement and market condition. Bowen *et al.* (2002) noted that timely completion of a construction project is frequently seen as major criteria of project success by clients, contractors and consultants.

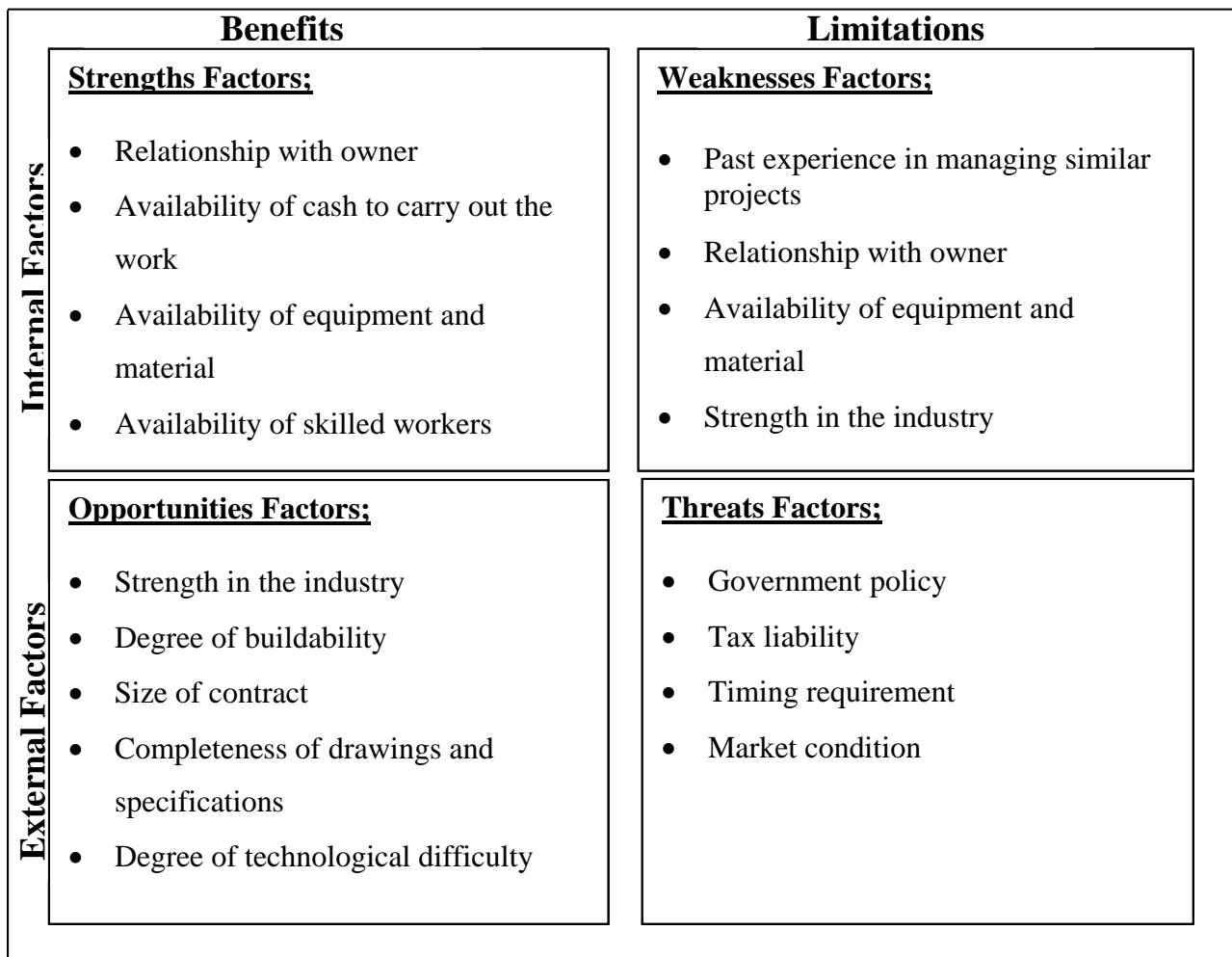


Figure 1. Framework for contractors' bid success

6 Conclusion

Generally in the construction industry, award of public projects has been based on a competitive process of bidding. Contractors are faced with the challenge of gaining entry into the standing list of the client and therefore must meet up with the required standard of technical and financial strength, social and economic conditions, management skills, good organization structure and operations and marketing ability (Shen *et al.*, 2006; Shen *et al.*, 2003). These among others are necessary for the achievement and maintenance of a sustainable competitive advantage as contractors bid for success. This study therefore reports the outcome of factors considered by contractors among others as shown in the framework that could influence their bidding activities. It is imperative for contractors to always conduct initial project research and embark on evaluation processes during bidding activities, and base on SWOT tool come up with an approach for a successful bid before committing much resource on the project.

7 References

- Ahmad R.O. (2011). Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis for farming system businesses management: Case of wheat farmers of Shadervan District, Shoushtar Township, Iran. *African Journal of Business Management*, 5(22), pp. 9448-9454.
- Akintoye, A. and Main, J. (2007). Collaborative relationships in construction: The UK contractor's perception. *Engineering, Construction and Architectural Management*, 14(6), pp. 597-617.
- Auriol, E. (2006). Corruption in procurement and public purchase. *International Journal of Industrial Organization*, 24(5), pp. 867-885.
- Ayub, A., Aslam, M.S., Razzaq, A. and Iftekhar, H. (2013). A conceptual framework on evaluating SWOT Analysis as the mediator in strategic marketing planning through marketing intelligence. *European Journal of Business and Social Sciences*, 2(1), pp. 91-98.
- Bagies, A. and Fortune, C. (2006). Bid/no-bid decision modelling for construction projects, In: Boyd, D (Ed) Procs 22nd Annual Association of Researchers in Construction Management (ARCOM) Conference, Birmingham, UK, pp. 511-521.
- Bee, L.O., Hing-Po, L. and Benson T-H.L. (2012). The effect of bidding success in construction bidding. *Engineering, Construction and Architectural Management*, 19(1), pp. 25-39.
- Bowen, P.A., Hall, K.A., Edwards, P.J., Pearl, R.G. and Cattell, K.S. (2002). Perceptions of time, cost and quality management on building projects. *Australian Journal of Construction Economics and Building*, 2(2), pp. 48-56.
- Celentani, M. and Ganuza, J.J. (2002). Corruption and competition in procurement. *European Economic Review*, 46(7), pp. 1273-1303.
- Egemen, M. and Mohamed, A. N. (2007). A framework for contractors to reach strategically correct bid/no bid and mark-up size decisions. *Building and Environment*, Vol. 42, pp. 1373-1385.
- Garbharran, H., Govender, J. and Msani, T. (2012). Critical success factors influencing project success in the construction industry. *Acta Structilia*, 19(2).
- Green, S., Harty, C., Elmualim, A. A., Larsen, G. D. and Kao, C. C. (2008). On the discourse of construction competitiveness.' *Building Research & Information*, Vol. 36, No. 5, pp. 426-435.
- Hoffman, N.P. (2000). An examination of the "Sustainable Competitive Advantage Concept: Past, Present, and Future" <http://nhoffmal@bcc.cba.ua.edu>
- Learned, E.P., Christensen, C.R., Andrews, K.E. and Guth, W.D. (1965). *Business Policy: Text and Cases*, Irwin, Homewood:IL.
- Ling, F. Y. Y and Liu, M. (2005). Factors considered by successful and profitable contractors in mark-up size decision in Singapore.' *Building and Environment*, Vol. 40, No. 11, pp. 1557-1565.
- Lu, W. (2010). Improved SWOT Approach for conducting strategic planning in the construction industry. *Journal of Construction Engineering and Management*, 136(12), pp. 1317-1328.
- Lu, W.S., Li, H., Shen, L.Y. and Huang, T. (2009). A SWOT analysis of Chinese construction companies in the global market, *ASCE Journal of Management in Engineering*, Forthcoming.
- Merna, A. and Smith, N. J. (1990). Bid evaluation for UK public sector construction contracts. *Proc Inst Civil Engineers*, Part 1, pp. 91-105.

- Nguyen, L.D., Ogunlana, S.O. and Lan, D.T.X. (2004). A study on project success factors in large construction projects in Vietnam. *Engineering, Construction and Architectural Management*, 11(6), pp. 404-413.
- Nouri, J., Karbassi, A.R. and Mirkia, S. (2008). Environmental management of coastal regions in the Caspian Sea. *International Journal of Environmental Science and Technology*, 5(1), pp. 43-52
- Olatunji, B. (2011). Construction industry rich enough to drive economy, www.google.com, accessed on 5th January, 2013.
- Shen, L.Y., Zhao, Z.Y. and Drew, D. (2006). ‘Strengths, Weaknesses, Opportunities and Threats (SWOT) for Foreign-Invested Construction Enterprises: a China Study’, *ASCE Journal of Construction Engineering and Management*, 132(9), 966-976.
- Shen, L. Y., Lu, W. S., Shen, Q. P. and Li, H. (2003). A computer-aided decision support system for assessing a contractor’s competitiveness.’ *Automation in Construction*, Vol. 12, No. 5, pp. 577-587.
- Singh, N. (2010). SWOT Analysis – A useful tool for community vision. A concept paper of central Himalayan village. *Res.*, 2(9), 16-18.
- Tan, Y., Shen, L., and Langston, C. (2010). Contractors’ Competition Strategies in Bidding: Hong Kong Study. *Journal of Construction Engineering and Management*, Vol. 136, No. 10, pp. 1069–1077.
- Tan, Y.T., Shen, L.Y., Khalid, A.G. and Song, S.C. (2008). An examination of the factors affecting contractors’ competition strategy: a Hong Kong study.’ *International Journal of Project Organisation and Management*, 1(1), pp. 4-23.
- USDA (2008). SWOT analysis a tool for making better business decisions. United States Department of Agriculture Risk Management Agency.
- Weihrich, H. (1982). The TOWS matrix: a tool for situational analysis, *Long Range Planning*, 15(2), 54-66.
- Wijewardana, C., Jayasena, H.S. and Ranadewa, K.A.T.O. (2013). Impact of government policies and regulations when adopting alternative procurement methods. The Second World Construction Symposium, 2013: *Socio-Economic Sustainability in Construction*, 14–15 June 2013, Colombo, Sri Lanka, pp. 253-260.

THE EFFECTS OF ARCHITECTURAL DESIGN ON SOUTH AFRICAN EXPANDED PUBLIC WORKS PROGRAMME GOALS.

Splaingard, Daniel Robert

Department of Architecture, Planning and Geomatics, University of Cape Town, Cape Town, Western Cape, South Africa

Abstract

Increasingly in South Africa, architects are requested to design buildings that meet the job-creation and training goals of the Expanded Public Works Programme (EPWP). In so doing, architects have a mandate to both design buildings and to design work for the poorest of the poor. This purpose of this study is to develop a useful framework for the assessment of measurable EPWP outcomes within architectural projects in this context. Based on Case Study research that utilized semi-structured interviews and data collection, this paper seeks to link data to the popular narratives of two reportedly successful projects, the Mapungubwe Interpretive Centre in Limpopo and the Ocean View/Mountain View Housing Development in Cape Town (Constable, 2013; Fagan, 2010). This paper proposes labour-intensity and certified training outcomes as key areas of measurement and presents data for each project. Findings from the two cases reveal great variability in the intensity of EPWP usage and the nature of the relevance of worker training for future employment prospects. The paper concludes with key areas for future projects to consider regarding labour-intensive construction and worker training goals, including identifying the challenges in aligning architectural innovation with certification standards for construction skills. Recommendations include careful selection of building technology to maximize labour-intensity and worker training outcomes. With the continued growth of the EPWP anticipated in coming decades, this paper takes initial steps to identify unique architectural strategies and establishes a quantitative baseline from which to compare future projects. (National Planning Commission, 2012).

Keywords: Architecture, EPWP, Labour-intensive construction, South Africa

1 Introduction

With the advent of the nation-wide EPWP in 2005, a methodology of labour-intensive construction was adopted by all public bodies in South Africa, prioritizing job creation and training in the delivery of infrastructure and new buildings (DPW, 2015). There are three primary EPWP goals: to provide income distribution through employment opportunities, to provide training and skills development to beneficiaries, and to build cost-effective and quality assets (DPW, 2015). This requires finding a balance between short-term employment goals and long-term building construction quality goals.

A review of the existing literature revealed no existing research specifically focused on architectural projects and the EPWP. This paper is an initial attempt to fill this gap by investigating the links between architectural design and EPWP outcomes through a pair of project level investigations.

Architects in this context are challenged to design economically empowering processes, not simply to design beautiful buildings. Most architectural design precedes the tender for building contractors. Therefore, architects must anticipate work outcomes even though it is at the discretion of building contractors to execute the work and manage workers on site. “*Architectural design “at the drawing board” is never neutral. It predetermines a set of relations around production.*” (Low, 1998). As this paper will reveal, “*imagination is certainly required in order to find ways to create employment.*” (McCutcheon, 2001)

The aim of this study was to explore the potential for architects to contribute to empowering others to work, to earn, and to grow in skills and independence.

2 Literature Review

2.1 Public Works Programmes

Anna McCord (2008) defines Public Works Programmes (PWP’s) as: “all activities which entail the payment of a wage (in cash or in kind) by the state, or by an agent acting on behalf of the state, in return for the provision of labour, in order to i) enhance employment and ii) produce an asset (either physical or social), with the overall objective of promoting social protection.” PWP’s are most commonly implemented in conditions of extreme poverty or seismic shifts in a nation’s economy prompted by war, famine, market collapse or conditions of structural unemployment (del Ninno, Subbarao, and Milazzo, May 2009). It is widely held that the first large-scale PWP to be established was the New Deal programme in the United States in the 1930’s (Auer & Leschke, 2005). During the period from 1935 to 1943 this programme produced 40,000 new and 85,000 improved buildings including an array of public buildings ranging from park houses and schools to libraries (Leighninger Jr, 1996). While elements of the New Deal included a modicum of training for workers, these programs primarily focused on employing already skilled people through economic stimulus (Ermentrout, 1982; Leighninger Jr, 1996). Globally a vast range of PWP’s operate with various programme designs and goals ranging from short term employment and job-counseling for the temporarily unemployed to income guarantee schemes that provide seasonal employment for participants. (McCord, 2008).

The EPWP is characterized as offering a single short-term episode of employment with an emphasis on skills training (McCord, 2008). Since its inception, a range of criticisms have been brought against the program, including critique of the fitness of the programme’s design to the context of South Africa’s economy. In 2008 the EPWP had only reached 11 percent of the officially unemployed, leading researcher Charles Meth (2011) to suggest that the program in South Africa is nowhere near sufficient in scale to address the need. Meth (2011) also evaluates the individual work opportunity, which averaged 4-6 months and involved 8-12 days of training, a very brief tenure to expect significant up-skilling. McCord (2005) echoes this concern; “The implicit assumption is that workers will metamorphosize from unskilled workers to skilled workers for whom there is unmet demand.” This lack of demand for low skilled workers is linked to the core problem of structural inequality present in South Africa (Philip, 2010).

The up-skilling of beneficiaries is central to the EPWP emphasis on certified trainings aligned with National Qualification Framework (NQF). Exiting the EPWP with an NQF recognized training certificate represent a best-case outcome of the program.

2.2 Labour Intensive Construction

McCutcheon (2008) explains that “labour-intensive construction results in the generation of a significant increase in employment opportunities per unit of expenditure by comparison with conventional capital-intensive methods.” Much of the literature related to labour intensive

construction focuses on the work of civil engineers and particularly road-construction as a labour-intensive output for beneficiaries. This is largely due to the potential to increase labour-intensity in this area through the selection of appropriate road-buildings methods. By contrast building construction, “is regarded as being inherently labour-intensive” due to the nature of the task work, which is by convention largely dependent on manual labour versus machines (A. Fitchett, 2009). While building construction has room for increasing labour it is seen to have less potential than many other areas such as roads. CIDB outlines a series of tactics for labour-intensification of building construction including recommended building technologies (CIDB, 2005). In Figure 1 EPWP identifies key areas with potential to increase labour-intensity within infrastructure projects involving building construction:

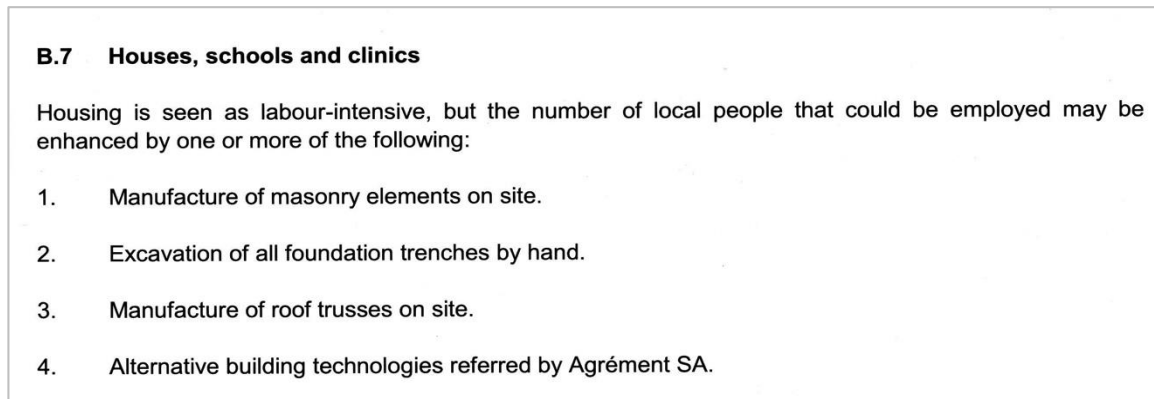


Figure 1. Excerpt from: Guidelines for the Implementation of Labour-Intensive Infrastructure Projects under the EPWP (2015)

2.3 Labour Intensive Architecture

Within the field of architecture less rigorous assessment of labour-intensive building technologies exists. Fitchett’s PhD (2009) contributes to an emerging knowledge in the South African context of building technologies and resultant labour-intensity. This builds on the work of Egyptian architect Hassan Fathy’s in the development of New Gournia in the 1970’s, an important precedent involving extensive local production of building materials and training of local people for construction. Fathy meticulously documented the strategies and decision within these labour-intensive construction projects (Fathy, 1973).

The recent publication of *Afritecture* (Lepik, 2014) popularized the narrative of job-creation and training goals within architectural projects across the African continent, including recent high-profile work by Mass Design Group in Rwanda. For the 6040m² Butaro Hospital in rural Rwanda, a reported 12,000 short term unskilled jobs were created while nearly 3900 skilled craftspeople were reported to be employed and received training on the job. (Murphy & Ricks, 2012) Here labour-intensive materials development and construction work was enabled through a design extensively using locally plentiful lava rock.

3 Research Methodology

The Case Study method was selected as appropriate to study this contemporary phenomenon in context. Given the enormous range of EPWP projects, two cases were selected to represent a divergent pair, rural and urban, once off and replicable. This research relied heavily on semi-structured interviews with key project participants. Interview protocol included ten standardized for each interviewees select customized questions²⁴The method of analysis involved making notes on the key content of each interview in order to construct a project narrative informed by the perspective of different participants. Following these

interviews, formal letters were submitted requesting official data for each of the two projects in addition to a database of all current EPWP projects. Data collected from the two projects was then amalgamated into a spreadsheet to generate new comparison between the two projects to assess how architectural design decisions affected EPWP outcomes.

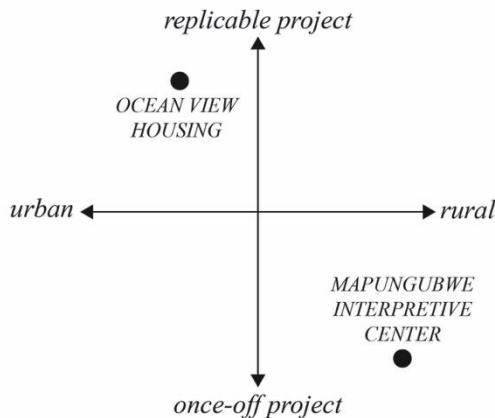


Figure 2. Project selection diagram

4 Findings and Discussion

4.1 Abbreviated Case Histories

The interviews revealed within each project unique forms of material and architectural innovation in pursuit of achieving the EPWP goals of labour-intensive construction.

4.2 CASE #1. Mapungubwe Interpretive Centre

4.2.1 Background

In 2005 South African National Parks (SANParks), a public agency within the Department of Environmental Affairs, embarked on the development of the Mapungubwe Interpretive Centre (MIC). They formed a competition brief to solicit design ideas from architects for a “*World-class Interpretive Centre to orientate all audiences regarding the Mapungubwe Landscape (cultural and natural)*” with a key mandate: “*The design of the building should be such that the construction methods should maximize the use of labour, job creation and skills development.*” (SANParks, 2005).

4.2.2 Architectural Design

From this competition Lerotholi/Rich Architects from Johannesburg lead by Peter Rich was selected as the winning design. Previously Rich had done extensive research of the Ndebele culture and had a unique understanding of the regional vernacular. In addition, he had worked in several community-based projects involving local production of material, primarily through the use of Hydraform pressed blocks. (Joubert, 2011) Uniquely with this project the design was conceived in conjunction with two MIT based engineers who had worked together at to develop a tile vaulting construction system used at the Pines Calyx in England to. The key innovation in this project was found in the use of high-tech engineering to create a dramatic structure built using low-tech site-made tiles. To achieve this intensive research and development was required.

4.2.3 From Design to Labour-intensive Construction.

Despite the identification of regionally available industrial made tiles, the team chose to build them on site using local unemployed people to both minimize environmental impact and maximize job-creation (Rich, 2015). In May 2005, a research team formed between MIT and the University of the Witwatersrand to develop an earthen tile that could be created on-site using a modified cinva-ram style hand-operated block press (Ramage et. al., 2010). To minimize the building's environmental impact, the team opted to design for only 5% cement content, creating the weakest tile that could safely support the structural loads (P. Rich, personal communication, April 6, 2015). Following a two-week demonstration-based on-site training (M. Hodge, personal communication, June 16, 2015), the tile manufacturing commenced in the production of 200,000 tiles.

To manage the tile production six Small, Medium and Micro Enterprises (SMME's) were developed. SMME development involved NQF Level 2 business training of individuals leading to registration with the CIDB. Each SMME was then responsible to manage a tile making team, typically comprised of eleven EPWP workers. The overall construction was managed by a local building contractor, who was charged with maximizing EPWP work opportunities for all aspects of labour within the construction.

4.3 CASE #2: Ocean View/Mountain View Housing

4.3.1 Background

Since 1994 over 2.8 million RDP houses have been built in South Africa with scores of currently ongoing projects throughout the country (EPWP, 2015; SA News, 2014). This sector of EPWP has high potential for scalable strategies for labour-intensive construction and is recognized within the National Housing Code. Ocean View/Mountain View Housing (OV) is a People's Housing Process driven RDP housing scheme of 543 houses located forty kilometers south of Cape Town. A community board selected Mellon Housing Initiatives to lead the construction and project management with over site from the City of Cape Town's Department of Human Settlements, who issued a tender for architectural services.

The rocky mountainous site had for years delayed development on this land earmarked for housing. However in 2006 civil site work commenced, grading the land for sites and roads and stockpiling the quarried stone (Constable, 2013). A breakthrough in the project occurred when the City of Cape Town approached the Provincial Department of Human Settlements with a proposal to approve funding to develop a stonemason training programme and retain the stone for housing construction instead of removing the stone to a landfill site (P. Houniet, personal communication, July 15, 2015). In addition, the project accessed the Mayor of Cape Town's Special Job-Creation Fund to support the stonemasonry training.

4.3.2 Architectural Design

In March 2012 the City of Cape Town advertised a Request for Services seeking architects experienced with stone masonry design. This tender did not specifically indicate the presence of EPWP within the project nor the necessity to design for labour-intensive construction but did solicit architects with stone construction experience. Cape Town based Two Think Architects and Greenhaus Architects formed a joint venture to respond to the unique context of the project and were awarded the tender.

4.3.3 From Design to Labour-intensive Construction.

Early house designs featured up to 80% stone facades (A. Spies, personal communication, May 12, 2015). Along with an expert stonemason one of the two project architects co-lead the design and implementation of the 6-month stone-masonry training, involving 30 trainees in both

classroom and site-based learning. By working with engineers to develop a load bearing stone wall that utilized both dressed stones for the façade and rubble infill, the architects were able to maximize the use of the available site material while generating additional work for the stone mason team. Uniquely, this involvement both in the design and training of stonemasons had a direct effect on the housing design, encouraging increased variety in the stone facades to provide useful training experiences for the stonemasons and visual intrigue to the neighborhood. Here goals for a diverse site plan aligned with goals to broaden the experience of the stone masons in the execution of a range of structural corners, curved walls, and other challenging skills (E. Bruwer, personal communication, July 10, 2015).

At Ocean View the innovative use of the site stone belies the fact that the majority of the construction method was more conventional and much of this also utilized EPWP trainees. While stone collection, refinement and installation increased the opportunities for EPWP beneficiaries, an abundance of conventional building elements including concrete block, cement tile for roofing, and gang-nailed wooden trusses were purchased and delivered to site from regional industrial producers. These too offer possible opportunities to further increase EPWP in the onsite production of buildings materials. In addition, as the project continued, plans were adjusted to decrease stone masonry and increase concrete block walls to save time and cost. Interviews revealed the challenges in managing EPWP workers and the high rate of turnover particularly in the early phases of the project.

As seen in Figure 3 in addition to this stonemason training at OV the EPWP Job Training took on a broad range of forms. With the exception of the stonemason training these were initiated by the Department of Human Settlements and Mellon Housing Initiative and independent of the architects' involvement.

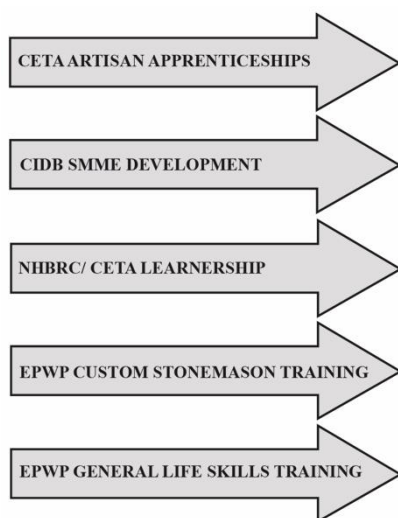


Figure 3. Training at Ocean View

4.4 Presentation of Collected Data

In this paper each of these projects is considered in relation to two key metrics; overall EPWP person-days and construction skills training deliverables. EPWP person-days (1 person day=8 hours of work) correlate to the goal of income relief through financial support transferred to participants. MIC generated 47,867 person days whilst OV (80% complete at time of data collection, including 2591 person/days of initial civil site work) generated 40,311 person days.

Table 1. EPWP wage transfer/labour-intensity evaluation table

Project	Mapungubwe Interpretation Centre	Ocean View Housing (Current August 2015)	Ocean View Housing (Projected Totals)
% Complete	100%	80%	100%
Total EPWP Person Days Worked	47876	40311	49741
Total Area of Building m ²	2753	23023	28779
EPWP Person Days/m ²	17.39	1.75	1.73

Table 1 reveals the total EPWP person-days for each project, and the ratio of EPWP person-day to the size of the constructed buildings. The purpose of this table is to isolate the use of EPWP as this programme aligns with particular government objectives for poverty relief and training distinct from the general labour market. This table does not refer to the total labour utilized in the completion of each project, which in both projects also featured the work of sub-contractors independent of the EPWP programme.

This study suggests a metric particularly relevant to understanding intensity of EPWP usage in architectural projects is EPWP Person Days/m². MIC featured EPWP usage of approximately 17 EPWP Person Days/m². The major contributor to this labour effort was in the production of 200,000 tiles for the vaults that totalled 28, 512 of the 47, 876 overall EPWP person-days. (SanParks 2015). The productivity of tile production at Mapungubwe and the efficiency of on-site materials production emerges as a key area in need of further investigation. Initial estimates for the expected output per tile-press were significantly higher than actual output, although the low wages associated with EPWP workers meant the overall costs for material production remained relatively low. (Fitchett, 2009a; Ramage et. al., 2010) Interviews revealed high levels of breakage in the transportation of the fragile tiles across the site as well as challenges in on-site vs. laboratory conditions of the tile production. (A. Fitchett, personal communication, March 28, 2015, F. Prinsloo, personal communication, July 12, 2015).

Based on the reported average of other RDP housing developments, the comparatively high level of EPWP hours at OV is apparent (EPWP, 2015). However, at OV the overall level amounts to 1.75 EPWP Person Days/m², much lower than MIC. Areas of potential increase to the EPWP Person Days/m² at OV include decreased purchasing of industrially produced materials in favor of on-site material production using EPWP beneficiaries.

The second measure of significance for this paper is “Construction Skill Training Deliverables” that emerge as outcomes that potentially enable workers to have improved job prospects beyond the time of the project.

Table 2. Construction Skill Training Deliverables

Project	Mapungubwe Interpretation Centre	Ocean View Housing (Current Aug. 2015)	Ocean View Housing (Projected Totals)
% Complete	100%	80%	100%
# CETA Construction Skill Certificates	0	24	48
# Non-Accredited Construction Certificates	0	32	32
% Workers Earning Construction Certificates	0.00%	2.15%	5.78%
Total SMME's Developed	6	2	2

Table 2 seeks to categorize key measurable training outcomes and SMME’s development for each project. As indicated in Figure 3, a range of possible outcomes exists within the training

of EPWP workers. Here CETA certified trainings are prioritized as specific evidence of construction skill development, with additional non-certified Construction Certificates also accounted for. This table shows that MIC generated 6 SMME's but no reported construction certificates. During the MIC project, accredited training was the responsibility of the Department of Environmental Affairs and information was not made available for this study. However, based on interviews with MIC project leaders, while general life skills training were facilitated throughout the project no reports of formalized construction skills trainings emerged.

Ocean View generated 24 CETA certificates for trainees in Painting and Carpentry/Joinery and 32 informal non-accredited certificates for the Stonemasons. It is projected that among the current Plumbing and Electrical trainees an estimated 24 will likely be certified by project completion. However, while many of these trainees were selected from the pool of EPWP workers, once entering the CETA 3-year apprenticeship programme they are no longer EPWP beneficiaries. This creates some ambiguity in assessing outcomes.

Architectural design had no apparent effect on these opportunities. Despite the best efforts of the project team, the stonemasonry trainings at OV failed to be recognized by CETA and to achieve an NQF Unit Standard. Ultimately participants were given a non-accredited certificate from the trainers in order to have tangible proof of their dedication and newly developed skills.

To construct the vaults at MIC, workers received on-site training in specific vault building techniques but this was not associated with any certifiable skill. Similarly the tile-making training, though useful to the production of tiles required for the construction was not associated with any NQF validated training to substantiate the workers efforts beyond the project. Beyond the SMME trainees, no MIC participants were reported to have received any form of skills training certificates.

The relevance of taught skills with respect to regional employment opportunities is an important consideration when architects select building technologies. While MIC generated high levels of EPWP person/days this was largely based in the production of tiles for a construction system anomalous to the region. By contrast, at Ocean View the stone masonry training shows initial signs of enabling future work opportunities, with the City of Cape Town and others in discussion concerning employment potential in the maintenance of historic stone structures, and stone walls on public roads. In addition, there are many stone buildings in the neighbouring suburbs that may allow for work opportunities in the open market.

Nonetheless, the SANParks brief called for a world-class building, and in 2010 MIC was selected as the World Building of the Year (Fagan, 2010). There can be little doubt this design has achieved this goal in addition to achieving high levels of EPWP wage transfer.

5 Conclusion and Further Research

A primary lesson from this research has been that architects should recognize, from the outset of projects, that material production on site offers the single greatest potential to increase EPWP labour opportunities (A. Fitchett, personal communication, March 28 2015). Additionally, it is important to anticipate the areas within the domain of architects to affect EPWP outcomes and those areas outside of their control. Finally, given the option, architects should choose building technologies and designs that align with certifiable skills, regionally useful techniques, and encourage management structures that develop local SMME's.

This research process has also revealed the challenges of utilizing data collected by agencies for EPWP reporting requirements to trace the specific impacts of architectural design on EPWP outcomes. In the future, focused researcher-lead data collection would assist in more precisely evaluating labour-increasing strategies and their connection to the work of architectural design.

5.1 Recommended Areas for Future Research

This study has identified the following areas for further research:

5.1.1 Project Level Studies of Training within EPWP

Further project level studies of training and certification processes within EPWP architectural projects are warranted. These should include understanding the duration, training costs and management structures within training programmes. Additionally, both projects of this paper raise questions concerning how “unit standards” can more flexibly align with innovative building technologies to validate training efforts.

5.1.2 Tracer Study of Ocean View Stonemasons

With Ocean View’s construction completion anticipated in early 2016, a follow up study on the work outcomes for this stonemason-training group may yield important understandings of the transition from EPWP work opportunities to finding employment in the labour market. This case appears to represent a real application of the EPWP ideals of “a better equipped work seeker” with potential for self-employment and a newly marketable skill.

5.1.3 RDP Housing and Local Material Production

The use of site based stone at Ocean View while defaulting to factory based materials for the majority of building components raises important questions about site-based material development and the inherent limits in terms of cost and management. Further exploration of this area could lead to a more defined position in future RDP developments.

5.2 Closing Thoughts

The EPWP presents a challenge and an opportunity for South African architects. Continued assessment and innovation within EPWP architectural projects can yield a South African architecture well suited to its cultural and economic context and expand the social and economic impact of architectural design.

6 Acknowledgement

This paper emerged from MPhil Research within the School of Architecture at the University of Cape Town. I would like to thank the Postgraduate Funding Office for their support of my research through the International Student Fund Scholarship and my thesis supervisor Iain Low for both critical feedback and encouragement. This research was made possible thanks to the cooperation of officials at SANParks, the City of Cape Town Department of Human Settlements, and the EPWP office in Pretoria. Willingness to be interviewed and to share project information afforded unique insight. Additionally, I am indebted to those interviewed from the project teams at Ocean View and Mapungubwe for their participation and feedback. Finally, I would like to thank Rae for support, good humour and encouragement throughout this research.

7 References

- Auer, P., & Leschke, J. (2005). *Active Labour Market Policies Around the World: Coping with the consequences of globalization*. International Labour Organization.
- CIDB. (2005). *Labour-based Methods and Technologies for Employment-Intensive Construction Works*.
- Constable, M. A. (2013) Ocean View: A New Hope for Future. *Urban Green File* - 0044, 2015, 42-43, 44, 45.
- del Ninno, C., Subbarao, K., & Milazzo, A. (May 2009). *How to Make Public Works Work: A Review of the Experiences*. Social Protection and Labor. World Bank, (NO. 0905)
- Department of Public Works. (2015) *Guidelines for the Implementation of Labour-Intensive*

- Infrastructure Projects Under the Expanded Public Works Programme.*
 Department of Public Works. (2015). EPWP 2014/2015 Quarterly Reporting Document. Excel spreadsheet.
- Ermentrout, R. A. (1982). *Forgotten Men: The Civilian Conservation Corps*. Exposition Press.
- Fagan, G. (2010, February). Mapungubwe Interpretation Centre by Peter Rich Architects. *Architectural Review*.
- Fathy, H. (1973). *Architecture For the Poor: An Experiment in Rural Egypt*. Chicago: University of Chicago Press.
- Fitchett, A. (2009a). *Skills Development and Employment Creation Through Small Public Buildings in South Africa* (Doctoral Dissertation). University of the Witwatersrand.
- Fitchett, A. (2009b). Employment Creation in Building. *IMIESA*, 34(6), 58-69.
- Leighninger Jr, R. D. (1996). Cultural Infrastructure: The Legacy of New Deal Public Space. *Journal of Architectural Education*, 49(4), 226-236.
- Lepik, A. (2014). *Afritecture: Building Social Change*. Hatje Cantz.
- Low, I. (1998). In Judin H., Vladislavić I. (Eds.), *Blank: Architecture, Apartheid and After*. Essay: Building and Self-Reliance. Nai Uitgevers Pub.
- McCord, A. (2005). A Critical Evaluation of Training within the South African National Public Works Programme. *Journal of Vocational Education and Training*, 57(4), 563-586.
- McCord, A. (2008). A Typology for Public Works Programming. ODI.
- McCutcheon, R. (2001). An Introduction to Employment Creation in Development and Lessons Learned from Employment Creation in Construction. *Urban Forum*, 12(3) 263-278.
- Meth, Charles. (2011) *Employer of Last Resort? South Africa's Expanded Public Works Programme*.
- Murphy, M., & Ricks, A. (2012). *Empowering Architecture: The Butaro Hospital, Rwanda*. Boston, MA: MASS Design Group.
- National Planning Commission. (2012). SA National Development Plan 2030. Executive Summary.
- Philip, K. (2010). Inequality and Economic Marginalisation: How the structure of the economy impacts on opportunities on the margins. *Law, Democracy & Development*, 14(1)
- Ramage, M. H., Ochsendorf, J., Rich, P., Bellamy, J. K., & Block, P. (2010). Design and Construction of the Mapungubwe National Park Interpretive Centre, South Africa. *ATDF JOURNAL*, 7(1/2)
- SA News. (2014). South Africa is a Success Story. Retrieved from <http://www.sanews.gov.za/south-africa/south-africa-success-story>
- SANParks. (2005). Brief to Architects. Mapungubwe Interpretive Centre. Unpublished manuscript.
- Watermeyer R., Band NG. (1994). *The Development of Small Scale Enterprises, Skills, Entrepreneurship and Employment Opportunities through the provision of housing*. National Housing Forum.

IMPEDIMENTS TO IMPLEMENTATION OF GREEN BUILDINGS IN SOUTH AFRICA

Saad, Mohammed Mustapha

School of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Witwatersrand, Johannesburg, Gauteng, South Africa

Abstract

The South African building industry has incorporated an energy standard, SANS2004 (Green Building in SA) and is busy incorporating a new standard, SANS 10400 XA, which aims to provide energy-saving practices as a basic standard in South African context. There is lack of speedy implementation of Green Building in the South African Republic. The purpose of implementing Green Building standards is to make the South African environment sustainable which will provide comfort to the end-users. Open-ended interviews were adopted to dig deep into challenges surrounding the poor implementation of Green Building standards. The respondents were construction professionals (Architects and Quantity Surveyors) that deal directly with the construction clients. A purposeful sampling strategy was adopted to identify professionals that have wealth of experience with Green Building projects. Thematic content analysis was used for data analysis. The finding shows that there are challenges with the implementation of Green Building standards, such as; Green Buildings are too expensive, lack of good communication, lack of team integration, the use of expensive technologies, etc. Therefore, for the South African building industry to achieve environmental sustainability there should be commitment to team integration and proper communication between all stakeholders involved to achieve its stated primary objectives of giving comfort to the end-users. It is recommended that further studies be conducted on the professional networking on sites, green washing problems, and encouraging developers to embrace green building techniques. It is also recommended to conduct further research in the public sector projects, such as the South African National and Provincial Departments of Public Works for purpose of comparison.

Keywords: Environment, Green Building, Implementation, Strategies, Sustainability.

1 Introduction

A Green Building is a building which is energy efficient, resource efficient and environmentally responsible. It incorporates design, construction and operational practices that significantly reduce or eliminate the negative impact of development on the environment and occupants. Buys and Hurbissoon (2011) have defined Green Buildings as the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle. Furthermore, the Green Building Council of South Africa (GBCSA) defines Green Buildings as a building which is energy-efficient, resource-efficient and environmentally responsible (GBCSA, 2013).

1.1 The state of Green Building in South Africa

South Africa has incorporated an energy standard, SANS2004 (Green Building in SA), which aims to provide energy-saving practices as basic standards in the South African context. There is, however, a need for The Green Building Council of South Africa (GBCSA) to investigate further in terms of the challenges affecting Green Building implementation in South Africa. The construction industry is responsible for a large amount of pollution that is produced around the world (Howard *et al.*, 2012). Buildings are one of the main users of electricity and therefore play a role in contributing towards global warming and the depletion of our natural resources (Rosenberg and Winkler, 2011). In order to reduce the effects caused by the built environment, there is a need to have changes in construction methods. These changes need to be implemented as quickly as possible in order to prevent more harm to the environment. These changes in construction methods are the changes from conventional construction methods to using Green construction methods. The developing world has started to adopt these strategies of sustainable construction and many developed countries are implementing Green Building techniques at an effective level (GBCSA, 2013). However, the developing world has been left behind. Only recently has South Africa started to take an active role in this evolution. According to Shi and Wei (2011), the GBCSA had awarded Green Star SA Ratings to only seven buildings in South Africa. The demand for going green does however, seem to be on the rise (GBCSA, 2013). The rapid growth of the building industry over the past few years has created a complex challenge between construction and its environment. Sustainable construction is an attempt made to restore this balance between the natural and built environments. South Africa's government and its private sector are becoming more conscious (Shi and Wei, 2011) of the need to practice construction in a sustainable way and to protect its environment.

However, compared to most developed countries, South Africa is still far behind (GBCSA, 2013) in this category. It is realized as though the environmental impact assessments (EIA) are struggling to balance the impacts linked with the social and the economic sides of the building environment. The Sustainable Building Assessment Tool (SBAT) has been used to fix this imbalance (Marelli, 2010). When it comes to "new" methods of developing sustainable construction, South Africa lacks the skills to achieve this successfully (GBCSA, 2013). Most small to medium sized companies cannot afford workers with technical and managerial skills as well as qualified professionals (Kats, 2003) to address these sustainable construction needs of the industry.

A conference on Public Involvement and Social Impact Assessments (Marelli, 2010) showed that public participation can play an important role in impact assessments and this resulted in stakeholder's consultations having a large impact on these assessments. This shows that a wider range of people are involved and have an influence in the construction process and that is why proper communication is vital to achieve success for sustainability (Korkmaz, 2012).

2 Literature Review

The world is currently facing a crisis with regards to global warming (Rehm and Ade, 2013). It is acknowledged that the construction industry plays a significant role in aiding the expansion of the global warming crisis. According to studies conducted by Rehm and Ade (2013), the construction industry is responsible for 40% of primary energy usage and it is also responsible for 36% of the emissions in the world which result from construction in industrialized countries. These emissions originate from the materials that are used in conventional buildings such as concrete and steel while others result from the use phase of buildings (Rosenberg and Winkler, 2011). According to a study conducted by Marelli (2010), the construction industry is responsible for about a third of the greenhouse gas emissions in the world and they contribute to the change in climate. Buildings in the European Union have been recorded to using up to 16% of the world's potable water; along with using up to 50% of raw materials and 40% of the

land waste comes from the construction industry (Rehm and Ade, 2013). With all of these negative impacts that the construction industry has on the environment, it is still a mystery why people are not embracing the implementation of Green Building. This clearly shows that there are various problems which are unsolved that are hindering the progress of Green Building implementation, especially developing countries like South Africa, such as: there is a gap between Green Building practices and legislation requirements; a high degree of unawareness of Green Building legislation/practices by construction company stakeholders; selective implementation of health and safety legislation requirements; and management staff had a more “positive” attitude to Green Building practices than site-based staff who tended to be less motivated and open to such practices (Windapo and Gaulding, 2015). Table 1 shows the rating based on the Green Star in South African building industry.

Table 1. Rating Achieved based on points in Green Star SA

Score	Rating	Remark/Title
10-19	One Star	Not eligible for certification
20-29	Two Star	Not eligible for certification
30-44	Three Star	Not eligible for certification
45-59	Four Star	Best Practise
60-74	Five Star	South African Excellence
75 and above	Six Star	World Leadership

(Source: GBCSA, 2013)

2.1 Climate Change in the City of Cape Town, South Africa

Assessment of current climate trends and future projections as an initial step towards developing a City Adaptation Plan of Action (CAPA) consolidates and integrates existing adaptation and climate proofing initiatives of the Western Cape Provincial Government, Cape Peninsula National Park and participating municipalities (Muheibir and Ziervogel, 2006). An initial step towards developing a CAPA would be to consolidate and integrate existing adaptation and climate proofing initiatives of the Western Cape Provisional Government (Muheibir and Ziervogel, 2006; Slabbert, 2013). Table 2 shows the Green Star rating based on best practice, South African excellence and World leadership.

Table 2. Distribution of Green Star SA rating

Rating	No of Buildings
Four Star	28
Five Star	5
Six Star	3

(Source: Derived from GBCSA, 2013)

2.2 Adapting to Climate Variability and Change

United States Aid for International Development’s (USAID's) development activities proceed through a design process that is generally refer to as the project cycle and it includes four basic steps, such as problem diagnosis, project design, implementation and evaluation (USGBC,

2009). USAID's Global Climate Change Team, in the Bureau for Economic Growth, Agriculture and Trade (EGAT), has been working to address the causes and effects of Climate change since 1991. USAID has funded programs that have reduced growth in greenhouse gas (GHG) emissions while promoting energy efficiency, forest conservation, biodiversity, and other development goals (USGBC, 2009). A cursory review of the U.S. Foreign Assistance Guidance on Operational Plans suggests that all five Objective Areas could feature projects and programs potentially impacted by climate.

To help project planners to understand and address the climate's impacts on their projects, the USAID Team has developed a Guidance Manual. This manual provides guidance on how to assess vulnerability to climate variability and change, as well as how to design or adapt to projects so that they are more resilient to a range of climatic conditions (USGBC, 2009). Climate change involves not only changes in an extreme weather patterns of wet and dry, hot and cool periods, but also changes to average climate, which means that systems and activities that are adapted to the average climate can be affected and that natural vegetation, such as forest or grasslands, exists in certain locations because the climate is favorable for particular species (Rehm and Ade, 2013).

2.3 Benefits of Sustainable construction

Sustainable construction is not only about implementing Green Building with internal measures that are energy efficient, but it also includes external measures such as the adoption of green roofing, for instance (Shoniwa, 2008). This is the process of buildings having a roof which has plantation, where buildings have materials like grass and trees that are planted on the roof. For instance, Green Buildings that have implemented green roofing have lots of advantages, such as a reduction in ambient temperature due to the cooling effect of the evaporation caused by the plants (GBCSA, 2013). The green roofs also provide shading, which in turn leads to a cooler space on the roof (Shi and Wei, 2011). Green roofs also create thermal comfort for occupants on the top floor who are directly under the green roof (GBCSA, 2013). Then the occupants under the green roof found the temperature comfortably moderate throughout the year. The main reason for the floor under the green roof being naturally cooler in summer is because of the evaporation and the water retention from the soil (Shoniwa, 2008). After understanding the benefits of Green Buildings, the question that arose was that "why do people not implement Green Buildings and always complain about the heat during summer and cold during winter"? Some of the answers that might come to the mind are that these facts have not been communicated to the construction clients. Moreover, the challenges within the context of South Africa is legislation enacted to control the design and construction of Green Buildings (in order to move towards a greater construction industry) are perceived to be "constraints/limited" (Windapo and Goulding, 2015), especially, compared to the implementation of Green practices within the building industry (Naidoo, 2008; cited in Windapo and Goulding, 2015). There is also the lack of sufficient knowledge from stakeholders' perspectives in understanding legislation to influence attitude and perceptions of Green Building legislation and practices to create a Green Building "mindset" (Naidoo, 2008; cited in Windapo and Goulding, 2015).

2.4 Green Building Rating Systems

This study has looked into the green building rating systems that are found in the world. In Australia, they have adopted a green building rating system which is called the "Green Star", this rating system was developed by the Green Building Council of Australia (Green Building Council of Australia, 2006). How this rating system works is that it rates a building's ecological performance by its functional factor and allocates a star to it.

In the United Kingdom, the Building Research Establishment Environmental Assessment Method (BREEAM) rating method is used. BREEAM classifies functionalities of the buildings

under categories such as: management; energy usage; health and wellbeing; pollution; transport; land use; ecology; materials and water (Lowe *et al.*, 2000). Then it assesses each factor and provides points to each factor then the points are added up to formulate an overall score. Once the score has been calculated, the certificate classifies the scores as pass, good, very good or excellence.

Japan has a green rating system that is called the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE). The CASBEE rates the building's environmental efficiency (performance and quality = Q), when it rates the environmental efficiency it looks at: indoor environment; quality of service and outdoor environment on site. Then it also rates the building's environmental loading (L), which comprises energy; resource and materials and the offsite environment (Adapted from United State Green Building Council, 2009). Then they divide Q by L in order to get a ratio which will rate the building's green measures. Then the certificate will sum up the calculated ratios and have symbols that represent the scores, which are: "C" for poor; then there is a "B" rating; "B+"; "A" and the last one is "S" for excellent.

In the United States, they use the LEED rating system which stands for the Leadership in Energy and Environmental Design (United States Green Building Council, 2009). This rating system categorises the green measures into six categories which are: Sustainable site; water efficiency; energy and atmosphere; materials and resources; indoor environmental quality and innovation in design process. All of these categories in a building are rated and then all the separate scores are put together in order to make one score rating of the building out of 69. Then in the certificate the final score out of 69 will be given a specific classification which will be either bronze; silver; gold or platinum which is the highest qualification.

The GBCSA (2013) has launched the Green Star SA, known as Public and Education Building Rating Tool that will allow all public spaces to be rated whether they are publicly or privately owned. The Council provides the commercial property industry with an objective measurement for Green Buildings and recognises and rewards environmental leadership in the property industry, whereby scoring is done in nine categories such as: Management, Indoor environment quality, energy, transport, water, materials, land use and ecology, emissions and innovations. A building development can receive either a 4-Star rating signalling that it has employed best practice, and a 5-Star rating which recognises 'South African Excellence' or the coveted 6-Star rating indicating that the project is a world leader.

In the first quarter of 2012, South Africa had one building with a Green Star Rating and this has now grown to nine, this year three were added just in the third quarter of 2012. The first development to receive a 5-Star rating was Aurecon Century City Office in Cape Town for its office design, indicating excellence in South African Standards, followed by Nedbank's new regional head office at the Menlyn Maine precinct development in Pretoria, which was awarded a 4-Star rating by Green Building Council of South Africa (GBCSA) for green office design and this is the third Nedbank building to achieve a four-star rating, joining the Nedbank head office in Sandton, Johannesburg and the Nedbank Ridgside office development in Umhlanga, Durban (GBCSA, 2013).

A four-star rating indicates "best standards practices", but the most important aspect of the entire Menlyn Maine project is its highest goal to become climate positive and once the full precinct – a mixed-use development of office blocks, shops, and living and entertainment spaces is complete, it will work toward reducing on-site greenhouse emissions to zero (GBCSA, 2013). Menlyn Maine is set to becoming Africa's first green city, one of 17 worldwide that fall under the Climate Positive program. Some of Menlyn Maine's green features include storm water tanks built into the structure and roof of buildings. The water will then be treated and circulated for reuse inside as well as outside the building and is expected to

provide non-potable water for almost a full year (GBCSA, 2013). The program, a Clinton Climate Initiative, recognises that while increased urbanisation is inevitable, cities can still grow in climate positive ways (USGBC, 2009).

3 Research Methodology

A qualitative research method was adopted for the study. This is to dig deep (Yin, 2009) to uncover facts (Saunders *et al.*, 2012) underpinning the phenomenon under investigation (i.e. Green Building implementation). The reason for the adoption of qualitative strategy is because the researcher wants to uncover the facts from construction professionals (Architects and Quantity Surveyors) that dealt with Green Building projects in South African building industry. It should be noted that there are no specific or permanent formulas for conducting a qualitative study (Leedy and Ormrod, 2010). Unstructured (in-depth) interviews were adopted to understand the meanings interviewees attach to issues and situations in contexts that are not structured in advance by the researcher (Easterby-Smith, 2008). The research was conducted in Johannesburg metropolitan council which is one of the three metropolitan councils in Gauteng province. Based on the literature reviewed, the best research strategy is by conducting in-depth interviews with construction professionals who deal directly with construction clients. Although interviewing is often claimed to be ‘the best’ method of gathering information, its complexity can sometimes be underestimated (Easterby-Smith *et al.*, 2008). Though, in this study, an in-depth interview was used, which was based on carefully prepared set of questions piloted and refined until the researcher was convinced of their validity. Interviews vary in accordance with the philosophical starting points that underpin them. Therefore, the epistemological and methodological bases of interviews and interviewing are necessary prerequisite in research designs that involve them (Silverman, 2001). The research was conducted with five (5) construction companies (where one professional was chosen from each company) that have dealt with Green Building projects in Johannesburg, Gauteng Province of South Africa. Five (5) relevant and experienced construction professionals (3 Architects and 2 Quantity Surveyors) who were registered with their professional bodies and have 20 years and above working experience with construction clients were interviewed for an hour. The construction professionals (i.e. Architects and Quantity Surveyors) are the once who construction clients consult for advice before embarking on Green Building projects. The construction professionals were chosen from grade 7 to 9 registered with the South African Construction Industry Development Board (CIDB).

4 Findings and Discussion

The private sector clients were chosen for the studies because of the wealth of experience gathered working with Green Building implementation over 20 years in the South African building industry. Thematic content analysis was used in the analysis of the data to identifying the recurring material or subject matter as well as identifying content that is noticeably different. The themes and constructs were identified from the interview transcript. The themes and constructs were ranked in frequency percentages (%) and results obtained are shown in Fig.1. From the analysis, four (4) factors were frequently ranked 100% (i.e. green buildings are too costly, lack of good knowledge about green buildings, lack of information on its benefits, and developers are building to sell not considering end-users comfort. Two (2) factors were frequently ranked 75% (i.e. lack of team integration between stakeholders and the use of expensive technologies). Three (3) factors were frequently ranked 50% (lack of good communication, no enough building regulations and the lack of stakeholders buy-in to the technology). From the outcome of the studies four major factors which all the five (5) respondents (3 Architect and 2 Quantity Surveyor) agreed were the most frequent impediments to the rapid implementation of Green Buildings. The major challenges uncovered by

construction professionals that led to poor Green Building implementation in the South African building industry include:

- Green Buildings are too costly
- Lack of proper knowledge of the advantages of Green Building
- Lack of information about its benefit to the construction clients
- Developers build to maximise profit only, not for users' comfort
- Lack of team integration within stakeholders
- Use of expensive technologies
- Lack of proper communication strategies
- No effective enforcement by professionals and government by-laws
- Lack of stakeholders buy-in to the technology

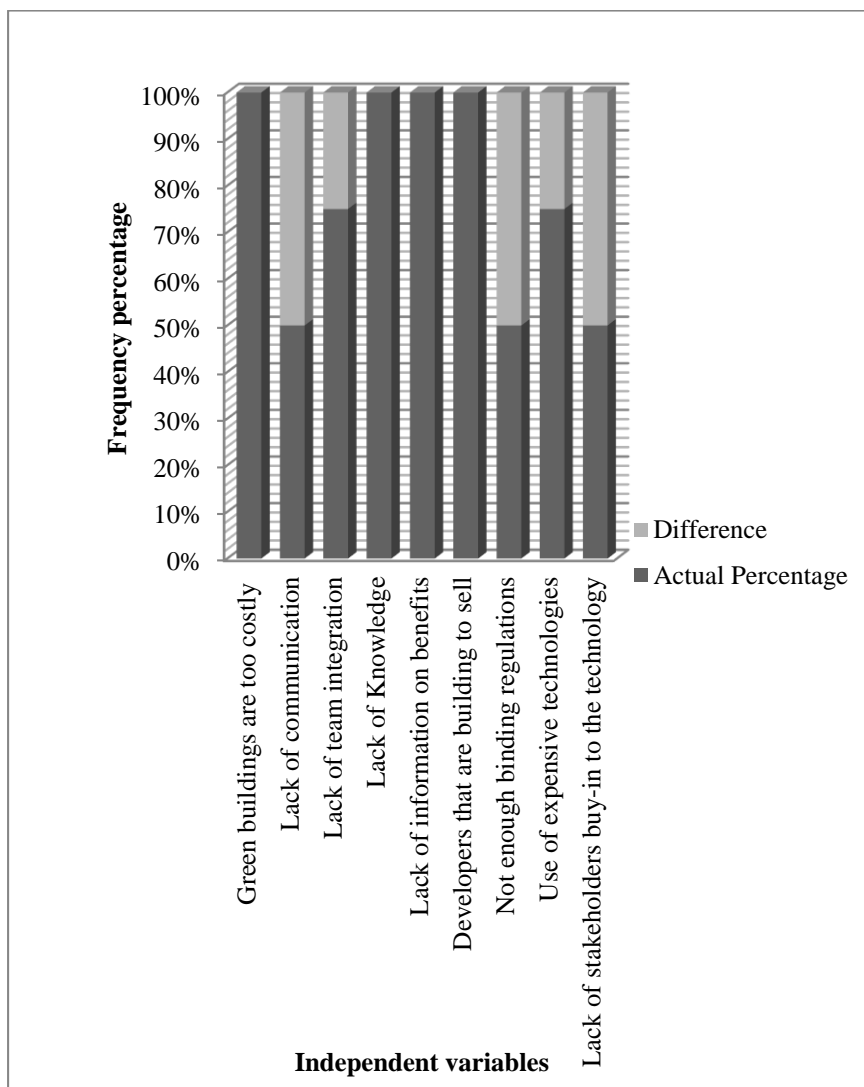


Figure 1. Challenges with the implementation of green building in South Africa

5 Conclusion and Further Research

From the data collected it is clear that Green Building implementation faces many challenges. The four (4) challenges that needed to be addressed as quickly as possible because of the alarming rate (i.e. 100%) are: Green Buildings are too costly, lack of proper knowledge of the

advantages of Green Building, lack of information about its benefit to the construction clients, and developers build to maximise profit only not for end-users' comfort. Despite the fact that these four (4) issues were the most challenging, does not mean the others challenges should be relaxed. For the South African Green Building implementation to succeed, the nine (9) challenges raised by this study need to be looked at critically and addressed to facilitate the speedy implementation of Green Building in South Africa.

The main recommendations of the study are that the concept of green development be broadened into other spheres apart from planners. As such the Green Building Council of South Africa (GBCSA) should broaden the awareness to the construction clients on the strategic advantage of implementing Green Buildings for the comfort of end-users. Again, based on the global warming challenges not only in developing economies, like South Africa, but the world at large, a reduction of green gas emission should be adopted in South Africa. It is also recommended to conduct further research in the public sector projects, such as the South African National and Provincial Departments of Public Works for purpose of comparison.

6 References

- Buys, F. and Hurbissoon, R. (2011), *Green buildings: A Mauritian built environment stakeholders' perspective*, Vol. 18, pp. 21-25
- Easterby-Smith, M; Richard, T. and Andy, L. (2008) *An Introduction of Management Research*, SAGE Publications, Ltd, London, ESZA 4PU
- Green Building Council of Australia (2006) *Dollars and Sense of Green Buildings*, Sydney
- Howard, B.; Parshall, L.; Thompsonc, J.; Hammer, S.; Dickinsond, J. and Modi, V. (2012), *Spatial distribution of urban building energy consumption by end-use*, Volume: 45 pp.141-151
- Kats, G. (2003), *Benefits of green buildings: A report to California's sustainable building task force*, pp. 12-19
- Korkmaz, S. (2012), Case-Based and Collaborative-Learning Techniques to Teach Delivery of Sustainable Buildings, *Journal of Professional Issues in Engineering Education and Practice* Vol. 138, pp. 139-144
- Leedy, P. and Ormrod, D. (2010) *Practical Research, Planning and Design* (4th ed.), New York: Macmillan Publishing Company
- Lowe, R., Kortman, J. and Howard, N. (2000) Implementing environmental assessment methods: three international case studies, *Proceedings of Sustainable Building Conference*, Maastricht
- Marelli, V. (2010), Green Destinations, Sustainable Construction in Southern Africa: Market Review, pp. 6-27
- Muheibir P. and Ziervogel G., August 2006, Fact, Framework for Adaptation, pp. 1-3, 5-15, 18-36.
- Naidoo, B. (2008), "SA accelerates green-building techniques amidst national electricity crisis", *Engineering News*, available at: www.engineeringnews.co.za/ (accessed 21 February, 2010)
- Rehm, A. and Ade, R. (2013), Construction costs comparison between 'green' and conventional office buildings, *Building Research and Information*, Issue 41, Vol.2, pp.198-208
- Rosenberg, S.A. and Winkler, H. (2011), Policy review and analysis: *Energy efficiency*

- strategy for the Republic of South Africa*, Available from: University of Cape Town
- Saunders, M.; Lewis, P. and Thornhill, A. (2012) *Research Methods for Business Students*, London: Pitman Publishing
- Shi, Q. and Wei, Y. (2011), *Advanced Materials Research*, An Equilibrium Model of Stakeholders' Interest for the Promotion of Green Building, Vol. 347, pp. 2754- 2757
- Shoniwa, M.R.K. (2008) *Implementing Value Engineering In Green Buildings for Energy Efficiency*; 13 November
- Silverman, D. (2001) *Interpreting qualitative data: Methods for analysing talk text and Interaction*, London: Sage.
- Slabbert, G. (2013) *The Emergence of Green Building Practices: Case Study of Stellenbosch*, Stellenbosch University, pp. 92-100
- South African National Standard (SANS 2004) Green Building Council of South Africa
- South African National Standard (SANS 10400XA) Green Building Council of South Africa
- The Green Building Council of South Africa (GBCSA), 2013 Report.
- United States Green Building Council (USGBC) (2009), accessed on the 24th of February, 2015, from; www.usgbc.org.
- Windapo, A.O., and Goulding, J.S. (2015), Understanding the gap between green building practice and legislation requirements in South Africa: *Smart and Sustainable Built Environment*, Vol 4, Issue 1, pp. 67-96
- Yin, R.K. (2009) *Case study research: Design and Methods*. SAGE Publications Inc. California, USA.

THE PERCEIVED BARRIERS TO THE CONSTRUCTION OF GREEN BUILDINGS IN NELSON MANDELA BAY, SOUTH AFRICA

Zenios, Marco; Allen, Christopher James

Department of Construction Management, School of the Built Environment, Nelson Mandela Metropolitan University, Port Elizabeth, Eastern Cape, South Africa

Abstract

The awareness of the need for the construction of Green Buildings (GB's) in South Africa has increased dramatically in recent years. There are numerous perceived benefits that are to be reaped from the construction of GB's that may provide long-term advantages for the owners of such buildings, however, obstacles to the construction of these projects continue to exist. This study therefore aims to identify what particular aspects are deemed to impact on the viability of constructing these projects when compared with traditional buildings and whether these perceptions are valid for all building types. Alongside a detailed literature review, a structured questionnaire was distributed amongst medium to large general contractor members of the East Cape Master Builders Association and members of the Eastern Cape Institute of Architects residing in Nelson Mandela Bay. The results of the research indicate that there is demand for GB's but that the perceived increased upfront costs, aligned to high material costs, minimum standard requirements and specialist knowledge required of the construction team, are the main obstacles that hinder the full adoption and construction of GB projects. The findings highlight that this is primarily due to insufficient knowledge and awareness existing amongst working professionals in the built environment of the region in terms of the requirements needed for the construction of GB's.

Keywords: Cost, Green Buildings, Specialist knowledge

1 Introduction

According to Harrison and Seiler (2011: 551) the past decade has seen recognition of the need for the awareness and implementation of sustainable initiatives within the construction industry through Green Building (GB) projects. GB's are a relatively new concept with regards to the Republic of South Africa (RSA) and numerous challenges still confront their construction. The establishment of the GBCSA in 2007 and the progressive development of the Green Star SA rating tool have provided the industry with an initial framework for financing, developing and investing in sustainable buildings (Windapo, 2014). Other countries such as the United Kingdom (UK), the United States of America (USA) and Australia are far more experienced and familiar with the construction processes and viability studies of green projects (McGraw-Hill Construction, 2013). However, the results from this research also show that South Africa, although starting from a low base of only 16% in 2012 is likely to see a 36% increase by 2015 to 52%, the greatest increase of those countries surveyed, a significant indication of the trend towards GB's now occurring. In addition, the research also identifies that South Africa has the highest level of green activity in the residential marketplace, with over a third (36%) of firms

reporting planned green activity for low-rise residential projects (one to three floors) by 2015. This statistic collides with the reported main challenges for GB's of higher initial capital costs and lack of political support/incentives. Pearce (2008) states that a significant barrier to sustainable construction is the perceived likelihood of a first cost premium linked to such projects. Jackson (2009) finds that almost three quarters of developers believe green construction developments add more than 5% to construction costs, whilst more than 40% of those respondents believe that costs actually exceed 10% when compared with conventional projects.

Globally, the construction environment generates many more pollutants when compared to other forms of industries and has an adverse effect on the natural environment, resulting in pollution of the earth (Ding, 2008; Durand *et al.*, 1996). It is therefore essential for the modern built environment industry to become aware of the need for the implementation of sustainable developments to reduce the amount of environmental impacts that the construction industry leaves on the natural environment. According to Verbruggen *et al.* (2010), contemporary society considers sustainable development as the best possible way to address these complex and interrelated problems, not only for the sake of current and future generations, but mainly for the future integrity of the planet and its natural environment. This is supported by McGraw-Hill (2013) showing that 44% of South African respondents believe the main reason for future GB's is that it is the right thing to do and Kibert (2013). This therefore suggests that there is great opportunity within the South African construction industry to grow sustainably by creating sustainably constructed buildings!

The greatest obstacle to implementation remains viability relating to the business case, which often results in the client omitting green building features (Milford, 2009). Due to the fact that construction professionals in South Africa are not entirely comfortable and practically acquainted with regards to the construction of GB's (Le Jeune *et al.*, 2013), this study is therefore highly important with regards to the analytical process followed when assessing the perceived reasoning for a GB. A vast number of professionals in the construction environment have as a perception that GB's cost more to construct when compared to conventional type buildings (GBCSA, 2012; McGraw-Hill Construction, 2013). The aim of the research was therefore to determine what aspects of GB's were perceived to be more expensive whilst the objective of the research was to identify whether: the acquisition of green/sustainable materials causes GB's to be more costly to construct; contractors impose higher profit mark-ups when undertaking green projects; the design phase is more expensive when compared to traditional type buildings, and; the acquisition of expertise relative to green projects is expensive.

2 Literature Review

2.1 What is a Green Building?

A GB incorporates design, construction and operational practices that significantly reduce or eliminate its negative impact on the environment and its occupants whilst providing an opportunity to use resources efficiently while creating healthier environments for people to live and work in (Indian GBC, 2007 & GBCSA, 2008). Chang *et al.* (2011) state that a GB is a structure that is designed, renovated, built, operated, or reused in an ecological and resource-efficient manner to incorporate energy efficiency, water conservation, waste minimisation, pollution prevention, resource-efficient materials, and indoor environmental quality in all phases of the building's life. There exist standardised benchmarks that are set globally in order to establish exactly which buildings do indeed meet the requirements to be able to be labelled as a GB with several rating systems in use, namely LEED (USA), BREEAM (UK) and Green Star (Australia). The GBCSA uses the Green Star South Africa rating system which is based on the Australian rating system but customised for the South African context (GBCSA, 2008).

With regards to GB projects, a holistic and integrated design process is utilised at the very beginning of the project process due to the fact that a GB comprises of many unique design features that are not necessarily found in conventional buildings (Kibert, 2008).

2.2 The need for Green Buildings

According to Dorsey and Hedge (2013) the global population is increasingly becoming more urbanised and as of the 23rd May 2007, over 51% of the world's population now live in urban environments (Hanlon, 2007). As buildings worldwide produce a vast scale of GHG emissions due to the fact that buildings constitute more than one third of total energy usage, the implementation of green practices and green projects have the largest potential for mitigating such adverse emissions into the natural environment (UNEP, 2009; Ade and Rehm, 2013). According to Jain et al. (2013) buildings do not stop impacting the environment once they are built – they have serious adverse effects on the natural environment throughout the life of the structure. Bhatia (2009) states that by implementing green practices, it is the best possible way to make the earth healthy for future generations; therefore all project stakeholders and civilians globally, are responsible to promote and adopt the concept of building green. Kneifel (2010) states that the implementation of energy efficiency measures within buildings can reduce their carbon footprint by 16% on average, therefore improving the GB LCC effectiveness.

The USGBC identifies that the optimal performance of a GB will be achieved when it is both energy efficient and effectively promotes the occupants' comfort within the building environment (Dorsey and Hedge, 2013). According to research in the Northern Hemisphere (Bayer-Oglesby et al, 2007), the average citizen spends more than 85% of their time indoors, therefore it is in their best interests that the built environment be created to provide for well-equipped ergonomically fit indoor environments to allow for high occupancy satisfaction rates and improved worker production outputs. Hedge *et al.* (2011) identify that amongst many traditional or conventional (non-green) office buildings there has been inadequate ergonomics design with regards to office workstations which results in the regular occurrence of work-related musculoskeletal disorders, a significant financial cost to any organisation. According to Arsenault et al. (2013) 'green buildings' prove to possess superior indoor environmental performance when compared with similar conventional type buildings' with a variety of physical features resulting in improved occupancy outcomes. Results from occupancy satisfaction surveys show that GB's score a much higher occupancy satisfaction rate when compared to conventional type buildings (Dorsey and Hedge, 2013).

According to McCown and Qualk (2009: 20) a theory referred to as the "triple bottom line", has become inherent in decision making when it comes to the construction of high-performance buildings. The theory posits that there is substantial occupancy satisfaction and the construction of the building enhances environmental conservation, with the building owner experiencing financial prosperity. The benefits can be measured and reproduced independently across a variety of project types and building locations. An example of this is energy efficient installation savings within the GB and the ability for the building owner to charge higher rental rates. Other quantitative benefits include water savings and carbon tax benefits, whilst qualitative benefits include fewer vacancies and better overall occupant health.

2.3 Obstacles identified with regards to the adoption of GB's

The primary obstacle facing the adoption of GB's is the perception that it costs more to construct such projects (Langdon and Morris, 2007; Hwang and Tan, 2012), whilst McCown and Qualk (2009) state that green design within a building is considered to be a feature that is added to the original cost of the design. Fletcher (2009) states that despite the benefits of long-term returns, it does indeed cost more to build green, however, evidence from LEED-certified GB's suggest a maximum of 1 to 2 percent more expense is incurred. In some circumstances,

this barrier inhibits sustainability construction from a business perspective as well as completely excluding consideration of such projects.

According to Pearce (2008) despite the overwhelming commitment to developing sustainable structures and buildings in the modern era, many organisations are experiencing difficulty with regards to implementing the concept of GB's due to the way in which funding is allocated. Ade and Rehm (2013) argue that the GB soft costs are higher than conventional type projects due to incremental costs incurred that are associated with the process of actually achieving a GB star rating. According to Baetz *et al.* (2010) these incremental costs include both application costs as well as additional consulting required with regards to the various rating tools.

Henn *et al.* (2008) states that there is always a risk that human bias towards traditional or conventional type building projects can hinder the adoption of green or sustainable projects. According to Tulacz (2008) although some contractors have already delivered and executed several LEED projects, most contractors remain sceptical with regards to the wholesale adoption of the GB agenda because it is perceived to pose additional requirements and risks. Duckles (2009) states that the process and the relative documentation is still evolving and burdensome for professionals in comparison with conventional projects whilst the USGBC Research Committee (2011) has identified strategic issues facing the GB community. According to Edwards *et al.* (2012) the shift to adopt GB projects has resulted in new industry boundaries and has presented contractors with unique challenges that could hinder or eliminate the achievement of green project goals. In both this research and that conducted in India (Jain *et al.*, 2013) similar obstacles were identified including the lack of professionals with the required knowledge and expertise to implement new or unfamiliar technologies and products; Sceptical sub-contractors who may instigate myths about sustainable construction and the administration costs associated with supporting compliance; The conflicts between existing building codes and GB strategies or standard requirements, and; The scarcity of the specified high-efficiency products or green materials that are included in the contract documents, crucial with regards to compliance with GB standards.

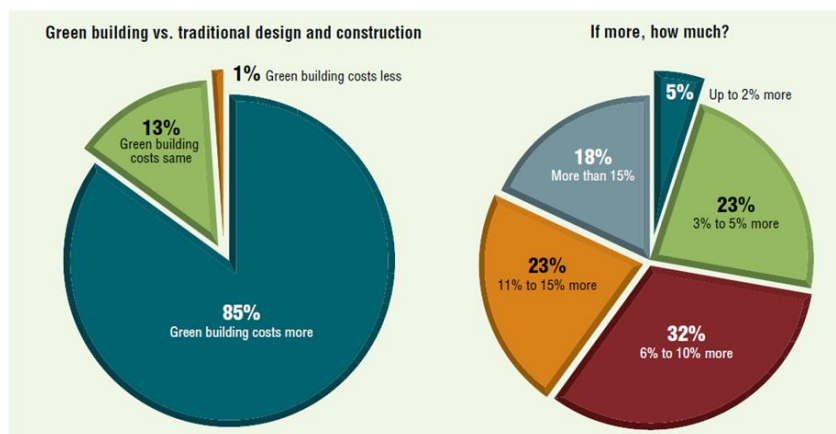


Figure 1. Market perceptions of GB construction costs (McCown and Qualk, 2009)

Malin (2000) states that environmentally friendly materials do in fact cost more due to limited production linked to these specialised materials and they need to be specially ordered – either through local supply yards or directly from the manufacturer. Extra costs are also incurred when additional technology is invested into responsible manufacturing. The most common misconception is comparing the cost of the green project with the original project budget / anticipated cost of the project. The outcome of this process results in contractors comparing the difference between what the final project was estimated to cost and how much it actually cost to complete. Cole and Sterner (2000) state that although LCC accounting is superior to

initial capital costs alone, it remains a limited approach to account for the broader environmental and social costs associated with GB's operating benefits such as lower energy and water consumption. Yudelson (2008), suggests it is a challenge to convince the developer to undertake a green project when there is unequal distribution of the benefits to the builder and tenants. According to Hwang and Tan (2012), developers have to often pay high upfront cost premiums for GB developments with inadequate information available with regards to green products or materials, while the tenants accrue the benefits from the improved performance in the indoor environment quality and cost savings, mainly related to water and electricity.

3 Research Methodology

The research was undertaken by conducting an empirical study using a quantitative approach in conjunction with a literature survey. The primary data for this study was obtained through a structured questionnaire sent randomly to 35 medium to large GC members of the ECMBA and 55 members of the ECIA drawn from a list of active members provided by each organisation. 17 members of the ECMBA responded and 13 members of the ECIA responded, providing a response rate of 48.57% and 23.64% respectively. Two Likert scale questions were used, the first ranges from 0-5, 0 being does not and 5 being major extent, whilst the second ranges from 1-5, 1 being minor extent, not at all, or strongly disagree and 5 being major extent, very, or strongly agree. Descriptive statistics in the form of frequencies, and a measure of central tendency, a mean score (MS), were computed from the data gathered using Excel. The responses are tabulated in terms of percentage responses in the range of 1 (minor) to 5 (major), and a MS with a minimum value of 1.00 and a maximum value of 5.00. MSs > 3.00 indicate that respondents can be deemed to perceive the extent of certain aspects affecting the need for the implementation of GB's are of a major extent as opposed to a minor extent, as in the case of MSs \leq 3.00. These descriptive statistics were organised, analysed, and presented in tables.

4 Findings and Discussion

Table 1; Table 2, and Table 3 indicate the extent to which certain aspects may affect the need for the implementation of GBs.

Table 1. The factors affecting the need for the implementation of green buildings

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor.....				Major		
		1	2	3	4	5		
The global increase in carbon emissions and greenhouse gases	0.00	0.00	10.00	30.00	50.00	10.00	4.44	1
The high maintenance costs linked to the life-span of traditional buildings	3.33	10.00	20.00	26.67	30.00	10.00	3.78	2
The increase of waste production on traditional construction sites	0.00	10.00	30.00	30.00	26.67	3.33	3.76	3
The adverse effect that the current traditional building industry has on the natural environment	0.00	13.33	33.33	20.00	30.00	3.33	3.69	4
The ever increasing levels of water pollution generated by the global construction industry	16.67	10.00	13.33	33.33	20.00	6.67	3.32	5
The current ineffective methods of traditional construction	0.00	23.33	43.33	13.33	16.67	3.33	3.24	6
The ever increasing levels of air pollution generated by the global construction industry	3.33	16.67	6.67	33.33	30.00	10.00	3.10	7
The current usage of VOC (Volatile Organic Compound) materials in traditional buildings	20.00	6.67	10.00	30.00	23.33	6.67	3.04	8
The ever increasing levels of noise pollution generated by the global construction industry	3.33	23.33	23.33	23.33	20.00	6.67	2.62	9

Eight out of the nine (88.89%) aspects listed in Table 1 have MSs > 3.00, which indicates that the grouped respondents of the GCs and architects can be deemed to perceive the aspects affecting the need for the construction of GB's as of major extent as opposed to minor extent. The grouped respondents perceived that the need for the implementation of GB's is mainly due to the fact that the current traditional building environment is emitting ever increasing levels of GHGs and carbon emissions with regards to the natural environment. This factor is ranked first with a MS of 4.44. None of the individuals responded 'Does not' to the factors which may imply that the respondents believe that all the factors listed do have a role to play with the implementation of GB's. When the responses for Architect's and GC's are separated in order to do a comparative analysis of the results an interesting dynamic occurs (see Tables 2 and 3).

Table 2. The factors affecting the need for the implementation of green buildings (Architects)

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor.....				Major		
		1	2	3	4	5		
Passive design within a green building provides better occupancy usage	0.00	7.69	7.69	0.00	38.46	46.15	4.08	1
Clients' preferences are changing towards the favour of green buildings	0.00	7.69	7.69	30.77	30.77	23.08	3.54	2
The inadequate ergonomics design with regards to office workplaces	7.69	15.38	7.69	15.38	30.77	23.08	3.42	3

Table 3. The factors affecting the need for the implementation of green buildings (GC's)

Aspect / Factor	Response (%)					Mean Score (MS)	Rank	
	Unsure	Minor.....Major					
		1	2	3	4	5		
Passive design within a green building provides better occupancy usage	5.88	5.88	11.76	23.53	35.29	17.65	3.50	1
Clients' preferences are changing towards the favour of green buildings	11.76	0.00	17.65	29.41	29.41	11.76	3.40	2
The inadequate ergonomics design with regards to office workplaces	11.76	5.88	23.53	29.41	23.53	5.88	3.00	3

All of the factors listed in Table 2 have MSs in the range of between $> 3.42 \leq 4.08$, which indicates that the architect respondents perceive these factors to have some extent to near major extent / near major effect in terms of the factors affecting the need for the implementation of GB's. In contrast, 66.67% of the GC factors listed have MSs > 3.42 , which indicates that they perceive only one of these factors to have the same affect. With regards to the architects' responses, they believe the no.1 ranked factor affecting the need for the construction of GBs is due to the fact that passive design within a GB provides for better occupancy usage. As a design based question, architects were more likely to respond in a more favourable manner towards this so it is notable that the GC's scored these aspects in the same order.

All but one (an unsure contractor) perceived GBs to cost 'More' to construct when compared with traditional buildings. This shows a very definite trend in opinion in terms of the perceptions of built environment professionals towards GBs. Respondents were also asked to choose an amount by how much more they believed GBs would cost (see Figure 2). The MSs of the responses proves to be quite a substantial amount, for both the architects and GCs. The architects' average percentage is 28.23%. The GCs' average percentage is 28.67%, a remarkably similar average, showing that built environment professionals believe it costs nearly a third more to construct a GB than a traditional building.

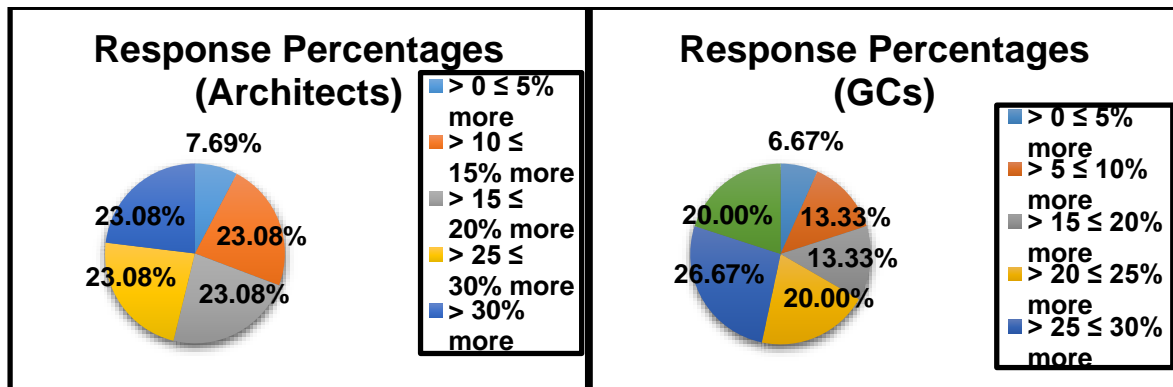


Figure 2. How much more GB's cost to construct when compared with traditional buildings

Having identified that both groups of respondents perceive there to be a cost implication when constructing Green buildings, understanding what factors are perceived to affect the construction from a cost perspective becomes paramount to not only better controlling those costs but also in terms of mitigating for those costs (see Table 4).

Table 4. The factors affecting the construction costs of green buildings

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor.....Major						
		1	2	3	4	5		
The expertise utilised	0.00	0.00	0.00	16.67	46.67	36.67	4.20	1
The building type	10.00	0.00	3.33	13.33	40.00	33.33	4.15	2
Materials used	0.00	0.00	10.00	20.00	33.33	36.67	3.97	3
The design process	0.00	0.00	13.33	13.33	50.00	23.33	3.83	4
The accreditation phases	10.00	3.33	13.33	23.33	20.00	30.00	3.67	5
Construction methods	0.00	0.00	13.33	26.67	43.33	16.67	3.63	6
Recycling of waste materials	3.33	10.00	6.67	23.33	30.00	26.67	3.59	7
The project location	6.67	3.33	16.67	36.67	16.67	20.00	3.36	8
The method of procuring materials	3.33	3.33	23.33	30.00	20.00	20.00	3.31	9
The site conditions	3.33	10.00	16.67	50.00	13.33	6.67	2.90	10

Respondents perceive 90% of the factors listed to have an important effect with regards to the construction costs of GB's with 7 having MSs in the range of $> 3.40 \leq 4.20$, which indicates that the respondents perceive the factors listed to have an important to more than important / more than important affect. The no.1 ranked factor perceived to affect the construction costs of GBs are the expertise utilised for the construction of the green projects.

Respondents were also requested to expand on the extent to which they believe certain benefits may exist with regards to the occupancy usage of GBs. The 1st to 6th ranked benefits listed have MS's that are in the range of between $> 3.34 \leq 4.17$, which indicates that the grouped respondents may perceive that the existence of these benefits with regards to the occupancy usage of GBs has some extent to near major extent / near major extent impact. In general these responses followed a similar pattern to that of the literature with "Improved indoor thermal conditions" ranked 1st whilst "Better speech privacy" was the only benefit that scored below 3.

Table 5. The extent to which respondents agreed with the following statements

Aspect / Factor	Response (%)						Mean Score (MS)	Rank
	Unsure	Minor.....Major						
		1	2	3	4	5		
The specialised materials utilised for the construction of green buildings imposes additional expenses with regards to the construction process	0.00	0.00	0.00	6.67	53.33	40.00	4.33	1
Green building developments are the best method of construction in which to improve the future integrity of the planet and its natural environment	6.67	0.00	0.00	10.00	43.33	40.00	4.32	2
There needs to be an improved awareness for the construction of green buildings	0.00	3.33	3.33	13.33	36.67	43.33	4.13	3
Green roofs pose high upfront costs	23.33	0.00	0.00	16.67	33.33	26.67	4.13	4
The accreditation phases required to obtain green star ratings imposes additional expenses to the project	16.67	0.00	6.67	6.67	40.00	30.00	4.12	5
The construction methods related to green buildings impose additional expenses	3.33	0.00	0.00	26.67	36.67	33.33	4.07	6

The life cycle cost benefits related to green buildings out-weigh the high upfront costs linked to such projects	26.67	0.00	3.33	13.33	33.33	23.33	4.05	7
The design process linked to green buildings imposes additional expenses to the project	3.33	0.00	10.00	10.00	43.33	33.33	4.03	8

Finally, respondents gave their opinion on a number of factors highlighted by the literature review as having an impact on the construction of green buildings. All of the statements listed have MSs > 3.00 which indicates that the respondents agree with all of the statements listed to some extent to near major extent / near major extent. According to the 1st ranked statement listed which has a MS of 4.33, the respondents perceive that the specialised materials utilised for the construction of GB's imposes additional expenses with regards to the construction process. The 2nd ranked statement listed in the question provides a MS of 4.32, confirms however that respondents perceive that GB developments are the best method of construction in which to improve the future integrity of the planet and its natural environment.

5 Conclusion and Further Research

The researchers have concluded that there is a certain amount of demand relative to the construction of GB's, however, due to the perception by the respondents of high upfront costs linked to the construction of such projects, the adoption of such projects is hindered. In addition, the respondents perceive there to be benefits reaped from the reduced LCC of GB's that out-weigh the high upfront costs of such projects, which challenges the notion that this should be a barrier to greater uptake of GB's in the region. However, respondents noted that GB materials are perceived to cost significantly more when compared to materials used for the construction of traditional buildings and that on the back of these higher material costs, general contractors tend to impose higher profit mark-ups when undertaking GB projects. Furthermore, individuals surveyed perceive the design phase relative to GB projects to be more expensive when compared to traditional buildings. Adding to this, respondents strongly agree with the fact that the expertise utilised for the construction of GBs imposes higher expenses. It was further noted by respondents that there needs to be an improved awareness and education required with regards to the working professionals within the built environment in order to increase their knowledge of what aspects constitute the construction of GBs.

As a result of this research, it is the opinion of the researcher that in consideration of those undertaking tertiary education as built environment professionals, there is a need to have specific education and training to acquire GB knowledge before they enter professional practice. Furthermore, in order to increase the adoption rate of GB's in RSA, it is recommended that the government should subsidise portions of the construction costs of GB projects in order for GB's to assist in meeting South Africa's commitments on climate change. The exact nature of these subsidies, possibly in the form of tax rebates or similar incentivisation schemes, should be investigated in future studies. Additionally, it is recommended that further studies should be undertaken to focus on the physical cost of materials used in the GB construction process, comparisons of the cost of expertise or the standard requirements that need to be met to achieve a GB rating in order to calculate the impact of these aspects on the total build cost.

6 References

- Ade, R. and Rehm, M. (2013). Construction costs comparison between 'green' and conventional office buildings. *Building Research & Information*, 41(2), pp. 199.
- Arsenault, C., Birt, B., Burns, G., Galasiu, A., Gover, B., Macdonald, I., Mancini, S., Newsham, G., Thompson, A. and Veitch, J. (2013). Do 'green' buildings have better

- indoor environments? New Evidence. *Building Research & Information*, 41(4), pp. 415-434.
- Baetz, B., Chidiac, S., Cupido, A. and Pujari, A. (2010). Evaluating institutional green building policies: a mixed-methods approach. *Journal of Green Building*, 5(1), pp. 115-131.
- Bayer-Oglesby, L., Edwards, R., Gauderman, W., Ilacqua, V., Jantunen, M. and Schweitzer, C. (2007). Indoor time microenvironment-activity patterns in seven regions of Europe. *Journal of Exposure Science and Environmental Epidemiology*, 17(2), pp. 170-181.
- Bhatia, N. 2009. Sustainable infrastructure and eco-efficiency. *The Times of India*, pp. 14.
- Chang, N., Rivera, B. and Wanielista, M. (2011). Optimal design for water conservation and energy savings using green roofs in a green building under mixed uncertainties. *Journal of Cleaner Production*, 19(11), pp. 1180-1188.
- Cole, R. and Sterner, E. 2000. Reconciling theory and practice of life-cycle costing. *Building Research & Information*, 28(5/6), pp. 368-375.
- Ding, G. (2008). Sustainable construction – the role of environmental assessment tools. *Journal of Environmental Management*, 86(3), pp. 451-464.
- Dorsey, J. and Hedge, A. (2013). Green buildings need good ergonomics. *Ergonomics*, 56(3), pp. 492.
- Duckles, B. (2009). *The green building industry in California: from ideals to buildings*. Unpublished PhD thesis. Tucson: The University of Arizona.
- Durand, E., Gobin, C., Pedregal, P., Peuportier, B., Polster, B. and Sommereux, I. (1996). Evaluation of the environmental quality of buildings towards a more environmentally conscious design. *Solar Energy*, 57(3), pp. 219-230.
- Edwards, D., Holt, G., Ofori-Boadu, A. and Owusu-Manu, D.-G. (2012). Exploration of management practices for LEED projects: Lessons from successful green building contractors. *Management of LEED projects*, 30(2), pp. 145-162.
- Fletcher, L. (2009). Green Construction Costs and Benefits: Is National Regulation Warranted? *Natural Resources and Environment*, 24(1), pp. 20.
- Hanlon, M. (2007). World population becomes more urban than rural. [Online]. Available: <http://www.gizmag.com/go/7334/> [Accessed 27 September, 2014].
- Harrison, D. and Seiler, M. (2011). The political economy of green office buildings. *Journal of Property Investment & Finance*, 29(4/5), pp. 551-554.
- Hedge, A., Puleio, J. and Wang, V. (2011). Evaluating the impact of an office ergonomics program. In: *Proceedings of the human factors and ergonomics society 55th annual meeting*, 19-23 September 2011, Las Vegas, Nevada, Santa Monica, California, Human Factors and Ergonomics Society, pp. 594-598.
- Henn, R. and Hoffman, A. (2008). Overcoming the Social and Psychological Barriers to Green Building. *Organization & Environment*, 21(4), pp. 394.
- Hwang, B. and Tan, J. (2012). Green Building Project Management: Obstacles and Solutions for Sustainable Development. *Sustainable Development*, 20(1), pp. 339-342.
- Indian Green Building Council (2007). Green building defined. [Online]. Available: <http://www.igbc.in/site/igbc/index.jsp> [Accessed 15 September, 2014].
- Jackson, J. (2009). How risky are sustainable real estate projects? An evaluation of LEED and Energy Star development options. *Journal of Sustainable Real Estate*, 1(1), pp. 91.
- Jain, M., Mital, M. and Syal, M. (2013). Obstacles and Catalysts Associated with Implementation of LEED-EB in India. *Environment and Urbanization ASIA*, 4(2), pp. 349-363.
- Kibert, C. (2008). *Sustainable construction: Green building design and delivery*. 2nd edition. New Jersey: John Wiley & Sons.

- Kibert, C. (2013). *Sustainable construction: Green building design and delivery*. 3rd edition. New Jersey: John Wiley & Sons.
- Kneifel, J. (2010). Life-cycle carbon and cost analysis of energy efficiency measures in new commercial buildings. *Energy and Buildings*, 42(3), pp. 333-340.
- Langdon, D. and Morris, P. (2007). What Does Green Really Cost? *The Green Issue Feature, PREA Quarterly*, pp. 55-58.
- Le Jeune, K., Nurick, S. and Roux, J. (2013). The business case for building green: Using life cycle cost analysis to motivate for energy saving design. In *Green Vision 20/20*. The South African Council for the Quantity Surveying Profession, pp. 105–116.
- Malin, N. (2000). The cost of green materials. *Building Research & Information*, 28(5/6), pp. 408-411.
- McCown, P. and Qualk, J. (2009). *The Cost Effectiveness of Building 'Green'*. Belfast: Penton Publishing.
- McGraw-Hill Construction (2013). *World Green Building Trends*, Available at: http://www.worldgbc.org/files/8613/6295/6420/World_Green_Building_Trends_SmartMarket_Report_2013.pdf.
- Pearce, A. (2008). Sustainable capital projects: leapfrogging the first cost barrier. *Civil Engineering and Environmental Systems*, 25(4), pp. 291 – 300.
- Green Building Council of South Africa (2008). *Technical Manual Green Star SA Office Design & Office as Built 2008*, Cape Town, RSA: GBCSA.
- Tulacz, G. (2008). The top green contractors. *Engineering News Record*, 261(9), pp. 116 – 118.
- United States Green Building Council Research Committee (2011). A national green building research agenda. [Online]. Available: www.usgbc.org/ShowFile.aspx?DocumentID=3402 [Accessed 01 September, 2014].
- Verbruggen, A., Waas, T. and Wright, T. (2010). University research for sustainable development: definition and characteristics explored. *Journal of Cleaner Production*, 18(7), pp. 629-636.
- Windapo, A. (2014). Examination of Green Building Drivers in the South African Construction Industry: Economics versus Ecology. *Sustainability*. 6088–6106. DOI: 10.3390/su6096088.
- Yudelson, J. (2008). *The Green Building Revolution*. Washington, DC: Island.

THE PRACTICE OF DESIGN-BUILD PROCUREMENT METHOD IN SOUTH AFRICA

Ilori, Babasola Olubunmi

*Department of Building Sciences, Faculty of Engineering and the Built environment, Tshwane
University of Technology, Pretoria, Gauteng, South Africa*

Talukhaba, Alfred Atsango

*Department of Building Sciences, Faculty of Engineering and the Built environment, Tshwane
University of Technology, Pretoria, Gauteng, South Africa*

Abstract

A well implemented good practice of Design-Build procurement method brings different disciplines and aspects of construction process together, which in turn minimises the incidents of constructors having to repeat work, and thus, result in cost and time savings. This type of procurement method increases the probability of a successful project that meets the expectations of all stakeholders. A bad practice of Design-Build procurement method increases the probability that the project’s performance will be compromised and that some or all of the stakeholders disappointed. Data were collected from consultants and contractors using a structured questionnaire via personal contact and email. The collected data were subjected to descriptive statistical analyses. This paper argues that design-build procurement is not correctly practiced in South Africa. This may be due to the late introduction and the level of understanding of the procurement method.

Keywords: Construction procurement, Contracting for Design-Build services, Design-build practices, Executing Design-Build projects, Procuring Design-Build services

1 Introduction

The design-build system is probably the oldest in the world. Master builders were providing buildings to meet the client’s individual needs long before architecture became divorced from the building process (traditional procurement method). Design-build is, therefore, a return to a former system which re-emerged in the post-war USA mainly for industrial and commercial projects, when architects tended to ignore their code of practice which precluded them from becoming contractors. By the 1970s many American architects were involved in design-build to the point where their institute was virtually forced to acknowledge the trend and approve it (Masterman, 1996).

Design-build started being used in America during the early 1900s (Greenfield, 1982). In the 1970s and 1980s, design-build was used extensively, especially in major power and industrial projects (Poirot et al, 1994). In 1991, about 5% of all construction in the USA was based on design-build (Setza, 1991). In the mid 1990s, more than one-third of construction projects were using the design-build approach and in response to the growing demand for it, the “Design-Build Institute of America” was set up.

The client’s knowledge and understanding of the construction and project implementation has been regarded by many researchers like Morledge (1987) as critical characteristics in terms of client behaviour when dealing with the construction industry. Behavioural responses exert a

significant influence on the effectiveness of the project management process because of the views of the various professions and skills involved, many of which have strong allegiances and perceive projects from very different positions (Walker, 1996).

An empirical survey conducted by Mbanjwa and Basson (2003) indicates on a scale of 1 to 5, with 1 indicating no knowledge and 5 indicating excellent knowledge, that the traditional procurement system was rated the most favoured form of procurement systems, followed by construction management (ranked 2nd), management contracting ranked 3rd; design and build (turnkey) ranked 4th; and design and manage including (build, operate and transfer) ranked 5th. This shows that design-build is still not well understood in South Africa thereby affecting the way design - build is practised and implemented.

Problems stemming from design-build practice may be traced to the following two factors:

Firstly, the late introduction of this procurement system into the South African construction industry compared to other countries especially in Europe. Construction Industry Development Board (CIDB, 2008) stated that construction procurement emerged in South Africa in 1994; one should compare this to a country like the United Kingdom in which different procurement systems were very much in use as early as 1950 (Masterman, 1996). The second is that of perception; South Africa being a developing country where information about this new procurement method is still lacking, clients may view design-build projects in a certain way influenced by their level of understanding of the method. Galbraith (1995) suggested that all clients will be influenced more by experience when choosing their procurement strategy than by project-specific factors.

This paper argues from stakeholders' opinion that design – build is not well practised in South Africa and also lack of understanding of the design – build procurement method. A better understanding of the practices of design-build procurement method will allow more clients to use this procurement route which has been proven to demonstrate superior performance in some types of projects. Studies have shown that its use results in improved time performance (Ling, 2004).

2 Literature Review

2.1 Design – Build Defined

Richard (1975) referred to “design-and-build” (also known as design-build) as a situation when a client contracts with a single firm in both design and construction. For Harold (1976) it is present when a substantial amount of building is accomplished under a single contract, covering both the design and building of the project (construction). According to Balogun (1992), design-build is a contract in which a building contractor does some or all of the design work and produces the building very quickly, particularly if the contract is a negotiated one. Ellis (1990) pointed out that with design and construction work under one roof, the contractor's knowledge of the building process is incorporated in the design process.

Forms of suspicion are eliminated because those responsible for design-build are able to perceive themselves as members of the same team, unlike in the traditional method. In addition, the line of communication becomes short and relatively informal. Arguing the case for design-build, Titmus (1982) remarked that the traditional competitive tender process is increasingly losing favour, especially as competitors are often unequal in standing and ability, which causes the project to be eventually executed in an atmosphere of “them and us”.

According to Finlay (1983), this form of project procurement may be on a fixed price or cost reimbursement basis. It may also be competitive or negotiated. Examples of such projects include factory buildings, medical clinics, and schools using a proprietary system, where benefits can be obtained. Also, where a contractor's proprietary system can be used without

detriment to the client's requirements, economic advantages stem from a modified form of design-build. Jones (1984) referred to this system as one where the designer is also the builder of a project. All these definitions can be summarized thus:

“Design-build system is when both design and construction are included in a single contract between the owner and the contractor either on a lump-sum or cost-plus basis e.g. housing and industrial constructions or an arrangement where one contracting organization takes sole responsibility, normally on a lump sum fixed price basis, for the bespoke design and construction of a client's project. The fundamentals of this procurement method are that the responsibility for design and construction lies with one organization and project carried out to meet the needs of the client”.

Asides the introduction and reference sections, sub-sections are allowed as outlined here. Similarly, further sub-sections are allowed as seen below

2.2 Construction Procurement in South Africa

According to CIDB (2008), construction procurement in South Africa evolved in 1994 when the South African Ministry of Public Works identified an urgent need for public sector procurement reform as regards construction projects. After an initial review of the regulatory environment that impacted upon procurement, it was concluded that such reform could not be undertaken on a sector by sector basis since a fundamental review of the entire public sector procurement system was required.

As a result, a joint initiative was embarked upon by both the Ministries of Public Works and Finance, the outcome of which was the release of the Green Paper on Public Sector Reform in 1997. A Procurement Focus Group was established by the Inter-ministerial Task Team for Construction Industry Development in 1999, at the request of the construction industry stakeholders, in order to examine aspects of construction procurement and delivery management. In 2000, this Group recommended that a uniform and standardized procurement system be established for the construction industry. In the process of doing so, CIDB was faced with a major challenge to develop a procurement system that would:

- Be compatible with the supply chain management framework that was being established by the National Treasury in terms of the Public Finance Management Act, 1999 and the Municipal Finance Management Act, 2003;
- Serve the needs of a decentralized public procurement system in terms of which the accounting officers or accounting authorities in organs of state would be responsible for their own procurement processes, and
- Be attractive to and serve the needs of the private sector

2.3 Design-Build Practices

DBIA (2014) identified best practices of design – build that can be applied to any type of design-build project and can effect project performance as divided into three primary sections. These include the following:

- A. Procuring Design-Build Services,
- B. Contracting for Design-Build Services and
- C. Executing the Delivery of Design-Build Projects.

A. PROCURING DESIGN-BUILD SERVICES

DBIA identified the following as three (3) best practices for owners:

(1) Conduct a proactive and objective assessment of the unique characteristics of its program/project and its organization before deciding to use design-build. (2) Implement a

procurement plan that enhances collaboration and other benefits of design-build and is in harmony with the reasons that the owner chose the design-build delivery system. (3) Use a competitive design-build procurement that seeks price and technical proposals should: (a) establish clear evaluation and selection processes; (b) ensure that the process is fair, open and transparent; and (c) value both technical concepts and price in the selection process.

B. CONTRACTING FOR DESIGN-BUILD SERVICES

DBIA identified the following as three (3) best practices:

(1) Contracts used on design-build projects should be fair, balanced and clear, and should promote the collaborative aspects inherent in the design-build process. (2) The contract between the owner and design-builder should address the unique aspects of the design-build process, including expected standards of care for design services. (3) The contracts between the design-builder and its team members should address the unique aspects of the design-build process.

C. EXECUTING THE DELIVERY OF DESIGN-BUILD PROJECTS

DBIA identified the following as four (4) best practices:

(1) All design-build team members should be educated and trained in the design-build process, and be knowledgeable of the differences between design-build and other delivery systems. (2) The project team should establish logistics and infrastructure to support integrated project delivery. (3) The project team, at the outset of the project, should establish processes to facilitate timely and effective communication, collaboration, and issue resolution. (4) The project team should focus on the design management and commissioning/turnover processes and ensure that there is alignment among the team as to how to execute these processes.

3 Research Methodology

65 questionnaires were distributed, 40 completed forms were received, representing a response rate of 62 percent. Fifteen (37.5%) were construction managers, seven (17.5%) were engineers, 13 (32.5%) were quantity surveyors, one (2.5%) civil technicians, one (2.5%) town planner, one (2.5%) building surveyor and two (2.5%) others. Unfortunately, there was no response from architects which causes the results not to reflect the latter's' opinions.

Research was carried out through the use of questionnaires in two ways:

1. Structured interviews with managers and directors of companies who are known to be stakeholders in the South African construction industry using questionnaires. These included the construction managers, quantity surveyors, project managers, engineers Interviews were conducted by running through the questionnaire and;
2. Emailing questionnaires to managers and directors of companies who were known to be stakeholders in the South African construction industry. The questionnaires were self-administered by the respondents and expected to be sent back via email.

The respondents were asked to rate the extent to which they agreed that design-build is not correctly practised in South Africa, where 1 = strongly agree/always/very good; 2 = agree/often/good; 3 = undecided/regularly/average; 4 = disagree/rarely/bad; 5 = strongly disagree/never/very bad depending on the type of question. Respondents were also invited to furnish their comments, state other design-build related problems and rate them.

This study adopted an opinion research approach to gather useful information on the design-build method. Data from the survey were first entered manually on a data sheet with coded variables. Data from the forty questionnaires were then analysed and evaluated using the Statistical Package for Social Sciences software (SPSS). A chi-square test of the mean and

Spearman's rank correlation were carried out with the help of SPSS to find out whether the stakeholders' opinions agree with the statements or not. In addition the frequency tables were computed using the SPSS and results presented using bar charts.

The major study was carried out in Gauteng Province which includes both Pretoria and Johannesburg while the remaining study took place in Kwazulu Natal and Mpumalanga Provinces. This is because the majority of construction activities are concentrated in Gauteng Province both in terms of size and complexity.

4 Findings and Discussion

The chi-square test results show that design-build contracting is not correctly practised in South Africa ($X^2 = 11.4000$, $P \leq 0.05$). The results also show there is a significant level of agreement by the respondents that there is a problem in the way design-build contracting is practised in this country.

Table 1. Design-build contracting is not correctly practised in South Africa

Q2.3 (V8) Rating	Frequency	Percentage	Cumulative %	Cumulative Freq.
Strongly agree (1)	3	7.5	7.5	3
Agree (2)	10	25.0	32.5	13
Undecided (3)	18	45.0	77.5	31
Disagree (4)	9	22.5	100.0	40
Chi-square test (X^2) = 11.4000		P. value = 0.0097 \leq 0.05		

Explaining the problem further as reflected in the frequency table (Table 1, column 2), most respondents are not sure whether design-build is correctly practised in South Africa. This can be attributed to the discussion above that the design-build method is not well understood due to late introduction of the method in South Africa and wrong perception about how its processes are carried out, see figure 1 below illustrating the frequency. A total of 18 (45%) were undecided, followed by ten (25%) in agreement, while only nine (22.5%) disagreed and the remaining three (7.5%) strongly agreed.

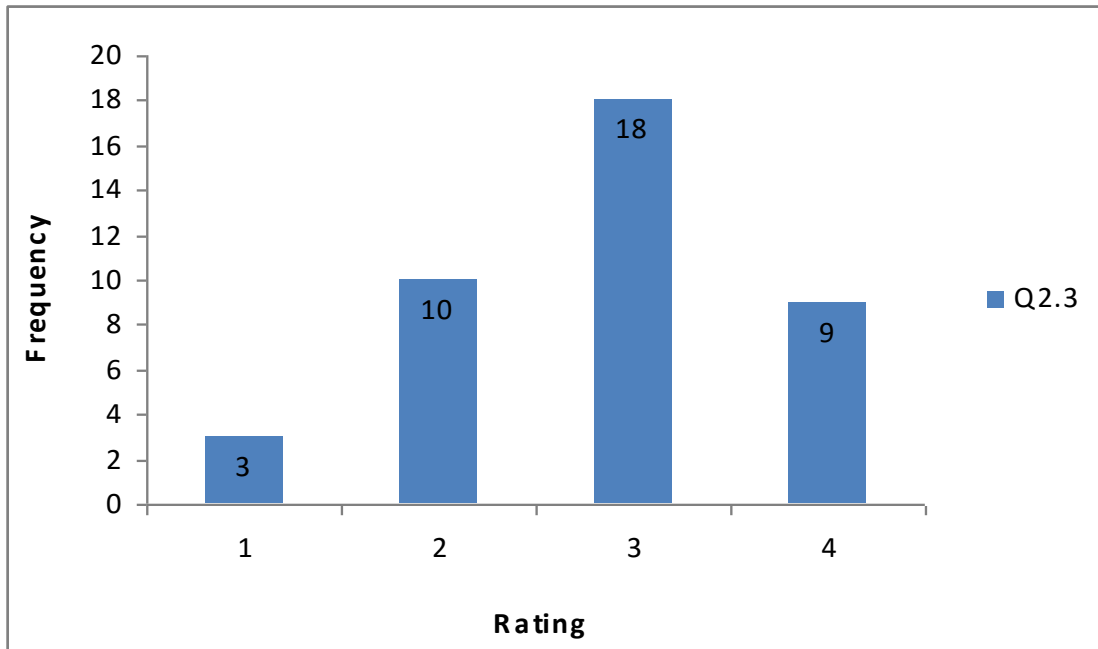


Figure 1. Frequency of responses regarding whether design-build is correctly practised in South Africa (Bar chart).

5 Conclusion and Further Research

From the findings design-build procurement method is not well practiced in South Africa. Also design-build is not well understood due to lack of experience and exposure. In order to effectively improve the practice of design-build projects in South Africa, it is recommended during implementation the clients should use a procurement process that: (a) focuses heavily on the qualifications of the design-builder and its key team members rather than price; and (b) rewards design-build teams that have a demonstrated history of successfully collaborating on design-build projects. Also the clients must identify and involve key project stakeholders at the early stages of project. All design-build team members should be educated and trained in the design-build process, and be knowledgeable of the differences between design-build and other delivery systems.

This study contains several limitations. Firstly, the responses gathered from stakeholders were based on their perceptions, which are subjective. Secondly, different respondents may hold different views on the points of the rating scale. While two respondents may have rated an answer as 3 (undecided), they may nevertheless not encounter the same level of difficulty as regards the issue identified. Lastly, the composition of the respondents did not include any architects because no responses from the questionnaire sent out stemmed from these professionals. Thus, there may be biases in the results against the architects' perception. In future, more data should be collected involving the architects and the public sector so that a more balanced comparison and conclusion can be made.

6 References

- Bolagun L. (1992). The search for alternatives construction system in Nigeria. Paper delivered at a workshop organized by the Nigerian Institute of Architecture; April 10. 1992.
- Rolls, E. T. (2007). *Emotion Explained*, Oxford, Oxford University Press.
- Design-Build Institute of America (2014). *Design-Build Done Right-Best Design-Build Practices*”, (available online <http://www.dbia.org/resource-center/best-practices>. [Accessed on 12/11/2015])

- Construction Industry Development Board Discussion Paper (2008). Developing the capacity and capability of those procuring engineering and construction works': CIDB South Africa;
- Ellis, M. (1990). Design and build survey. *Contract Journal*, June 14.
- Finlay, J. (1983). Refurbishment on the grand scale. *Chartered Quantity Surveyor*; July 16, 1983.
- Galbraith, P.J. (1995). The Development of a Classification System for Construction Industry Customers: EPSRC research report, Department of Construction Management and Engineering, University of Reading.
- Greenfield, S.S. (1982). Turnkey construction in the United States: *ASCE Journal of the construction Division*, 108(2), 201-201.
- Harold, D. H. (1976). *Building Contracts for Design and Construction*: John Wiley and Sons, Inc. Canada 2nd Edition.
- Jones, G.P. (1984). *A New Approach to the JCT Design and Build Contract*, London: Construction Press.
- Ling, F.Y.Y. (2004). How project managers can better control the performance of design-build projects. *International Journal of Project Management*, 22(6), 477-488.
- Masterman, J.W.E. (1996). *An introduction to building procurement systems*, London: E & FN Spon.
- Mbanjwa, S. and Basson, G. (2003). The use and effectiveness of construction management as a building procurement system in the South African construction industry, Pretoria: University of Pretoria, Faculty of Engineering, The Built Environment and Information Technology.
- Morledge, R. (1987). The effective choice of building procurement method. *Chartered Surveyor*; 26 July, 1987.
- Poirot, J.W., Kawaguchi, S.K., Carty, G.J. and Arens, M. (1994). More on Design-Build: *Engineering News Record*.
- Richard, H.C. (1975). *Construction Contracting*: John Wiley and Sons, Inc. Canada.
- Setzer, S.W. (1991). One-stop shopping has designers nervous: *Engineering News Record*.
- Titmus, R. (1982). The effective choice of building procurement method. *Chartered Quantity Surveyors*, June 26, 1982.
- Walker, A. (1996). *Project Management in Construction*" 3rd Edition, Blackwell Science Ltd.

PLANNING, HOUSING POLICY AND LOW INCOME HOUSING DEVELOPMENT IN SOUTH AFRICA

Musvoto, Elizabeth Mirika; Mooya, Many Mainza

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, Western Cape, South Africa

Abstract

Since the advent of democracy in 1994, post-apartheid South Africa spatial development policies have attempted to mitigate the severe, negative effects of the apartheid settlement patterns and to create more compact, efficient and sustainable settlements. As the government attempts to redress the legacy of apartheid, low cost housing provision remains its major focus. The White Paper on Housing of 1994 prioritised the needs of the poor, encouraged community participation and the involvement of the private sector. Since the inception of the White Paper several policies, programmes and legislation followed. However, two decades after the inception of such policies and significant levels of public and private sector investments, the South African low income housing landscape remains unchanged. Planning systems set rules and guidelines to control the supply and location of land usable for a full set of legally defined purposes independently of price and so influence the level, location and pattern of development activity. Using a literature survey, the aim of this paper is to examine the relationship between planning and low income housing development in South Africa, investigate the extent to which the planning system is aligned to the low income housing policies and evaluating whether planning regulations enable or constrain the provision of low income.

Keywords: Spatial planning, Low income housing development, Housing policy

1 Introduction

The impact of public policy on land and property markets is the subject of much interest and research. White and Allmendinger (2003) assert that many aspects of fiscal and regulatory policy impinge upon and affect markets in property and housing. However, it is the planning system in its various guises that has the most significant impact. While spatial planning is concerned with coordinating and guiding land uses and linkages between them, to balance demands for development with the need to protect the environment and to achieve social and economic development objectives, land use management is a regulatory mechanism which aims to increase the efficiency of the use of land and to ensure greater equity in that use (Evans, 2004 in Whitehead, 2006). According to Cheshire *et al.* (2002), planning systems set rules and guidelines that control the supply and location of land usable for a full set of legally defined purposes independently of price and so influence the level, location and pattern of activity. The ultimate role of planning is to promote a balance of environmental, social and economic welfare that meets the needs of current and future generations. According to Beer *et al.* (2007), planning as a form of regulation has been seen to occupy an equivocal position with respect to housing affordability in Australia. Planning can be seen to restrict the supply of land for residential development and impose additional costs on developers, at the same time planning bonuses and similar tools are considered potentially valuable in meeting the housing needs of low

income households. Adams & Watkins, 2002 and Whitehead (2006), attested to the idea that planning constraints impact on different groups of actors including developers, existing landowners and new purchasers since they lead to higher prices, densities, restrictions in the quantity of homes supplied and convergence in the type and design of homes.

According to Musvoto (2011), in the South African context, unsustainable and inefficient patterns of apartheid era planning persist for more than 20 years into the post-apartheid settlements. Compounding this situation are new, unsustainable emerging trends such as the continuing peripheral location of mono-functional low income housing developments (Musvoto, 2011). Although the planning system has remained largely unchanged for more than 20 years, attempts have been made through the Development Facilitation Act (DFA) and other planning policies to restructure the segregated cities. Huchzermeyer (2003) argues that the reason why segregated dormitory developments have prevailed since 1994 despite the vision and integrated planning tools was the neo-liberal and Marxist perspectives that cities and their residential component are shaped by the way they are financed.

As noted by various authors, the South African housing landscape is marred by a massive backlog of about 2.1 million houses, the low income housing units are poorly built (40 000 units have poor workmanship), located at the periphery of towns far away from amenities, thereby intensifying urban sprawl and increasing the daily reproductive costs of the poor (Newton and Schuermans, 2013; Seekings, 2000; Jenkins, 1999). The apparent reasons for this as noted in Venter *et al.* (2004) include greater affordability of land on the urban periphery as opposed to expensive land in the more central areas, coupled with insufficient subsidy amounts to build at higher densities to offset the higher land costs. The debate on combating urban sprawl has been highly supported by various policies in South Africa as it makes the core principles of the DFA which was intended to guide all the all physical planning and development and are embedded in the White Paper on Urban Development (1997), the Breaking New Ground policy of 2004, the Inclusionary Housing Policy of 2007, and the Spatial Planning Land use Management Act of 2013. Todes (2003) highlights that emphasis on restructuring away from an apartheid urban form and on creating more integrated cities has meant that the location and form of housing for low income households is a key concern, as such, the urban form of cities is continuously being challenged by urbanisation.

As the Government attempts to redress the legacy of apartheid, low income housing provision remains its major focus. The aim of the White Paper on Housing (1994) was to “*create viable, integrated settlements where households could access opportunities, infrastructure and services...*” Besides the focus on the budgets, subsidies and other institutional arrangements, the White Paper on Housing focused on land and planning issues as they impacted housing delivery. It clearly states that, “*The historical and existing patterns of land use and allocation as well as the legislative framework associated to land, provides an immense challenge and constraint. A fundamental approach will be required to make the housing programme a sustainable reality*”. In this instance, the White Paper acknowledged the dysfunctional human settlements that were inherited from the apartheid era. These are still the same issues that are the cause of criticism in today’s low income housing settlements. According to Berrisford (2011), despite a widely acknowledged causation between old planning laws and the spatial legacy of apartheid, South Africa has been unable to effect major changes to the legal frameworks governing land use and land development. Until 2013, when the Spatial Planning and Land use Management Act, 2013 (Act 16 of 2013) was promulgated, the same laws that were used to implement apartheid’s segregation and inequality policies remained in use, with the exception of the Development Facilitation Act, 1995 (Act 67 of 1995) which was an interim law to speed up development with low income housing development in mind, until its demise in 2010, when most of its chapters were declared unconstitutional. This implies that some of

the problems associated with low income housing delivery in South Africa are linked to spatial planning and land use management.

While this paper examines the relationship between spatial planning and low income housing development in South Africa, it investigates the extent to which the South African planning system is aligned to low income housing policies, in the process giving a perspective on whether planning regulations enable or constrain the provision of low income housing from a theoretical perspective. It will be presented in 6 Sections. The second section discusses the evolution of post-apartheid housing and planning policy intervention. This is followed by the review of international literature on housing and planning in practice in Section 3. Section 4 presents the impact of planning on low income housing development in South Africa. This is followed by the gaps in literature and implications of the research in Section 5 and the conclusion in Section 6.

2 The Evolution of Post-apartheid Housing and Planning Policy Intervention

2.1 *White Paper on Housing (2004)*

The promulgation of the White Paper on housing in 1994 set the pace for all the housing policies, legislation and programmes that followed. According to Jenkins (1999), the White Paper on Housing of 1994 prioritised the needs of the poor, encouraged community participation and the involvement of the private sector to deliver 1 million houses in 5 years. While it incorporated the principles of spatial planning concepts such as compact cities, densification and unification of the urban fabric as highlighted in Restructuring Development Programme (RDP), the White Paper focussed on issues of budgets, subsidies and other institutional arrangements as well as the land and planning issues as they impacted on the delivery of housing. It highlighted the challenges associated with land and planning issues. As noted earlier, the White Paper acknowledged the dysfunctional human settlements that were inherited from the apartheid era which led to issues such as high rates of urbanisation, inefficient and inequitable cities marred with urban sprawl and dispersed rural settlement structures hampering service delivery, accessibility and there was a lack of a housing strategy defining the roles and responsibilities of all role players. One of the goals of the policy was to replace the land use and spatial planning system with a new approach and legislation that acknowledged the scarcity of land in the Republic, promoted higher densities and encouraged planning techniques that enabled social cohesion and had an impact on costs and efficient resource utilisation (water and energy).

2.2 *Development Facilitation Act, 1995 (Act 67 of 1995)*

According to Du Plessis (2013), the Development Facilitation Act, 1995 (Act 67 of 1995) (DFA) through its provision for the preparation of Land Development Objectives, represented the first step to a new spatial planning framework. Furthermore, the DFA provided for far reaching set of general principles for land development (the DFA Principles), the establishment of a development and planning commission and the establishment of one development tribunal for each province (Berrisford, 2011). These principles provided the legal source to guide post-apartheid spatial planning and were factored in all planning and land development decisions whether taken under the DFA or any other legislation (Du Plessis, 2013; Berrisford, 2011).

2.3 *GEAR (1996) and ASGISA (2006)*

The economic related policies such as the Growth, Employment and Redistribution Programme (GEAR) in 1996 and the Accelerated and Shared Growth Initiative for South Africa in 2006 identified planning and land use management as key areas requiring institutional reform, with

great emphasis on integrated planning and service delivery by all spheres of government (Harrison *et al.* 2008). Integrated Development Planning Process had to include a Spatial Development Framework (SDF) in each municipal IDP. Furthermore, important initiatives in planning arena included the adoption of the White Paper on Spatial Planning and Land Use Management of 2001, which proposed a much stronger role for national legislation rationalising the provincial laws into one uniform set of national rules and procedures (Berrisford, 2011).

2.4 *Breaking New Ground (2004)*

Despite all the well-intended measures, the inequalities and inefficiencies of the apartheid space economy had lingered on. This led to the shift from developer to municipal oriented development through the birth of the Breaking New Ground Policy of 2004 (BNG). Based on the principles of the White Paper on Housing (1994), BNG was not introducing a new policy direction but merely emphasizing and outlining a comprehensive plan for the development of sustainable human settlements (Charlton and Kihato, 2006). According to Sishaka (2011), the policy substantially increased emphasis on the role of the State in determining the location and nature of housing as part of a plan to link the demand for and supply of housing. It also envisaged that municipalities would assume a greater responsibility for housing programmes in their areas of jurisdiction. Key elements of the BNG included (i) pursuing a more compact urban form through the introduction of fiscal incentives to promote the densification of targeted human settlements while introducing disincentives to sprawl, (ii) facilitating higher densities by investigating aspects of promoting densification such as planning guidelines, property taxation, zoning, subdivision, land swaps and consolidation as well as drafting a densification policy, (iii) mixed land use development, and (iv) integrating land use and public transport planning, so as to ensure more diverse and responsive environments whilst reducing travelling distances. The National Spatial Development Perspective (NSDP) and the draft National Urban Strategy were adopted to implement the elements of the BNG.

2.5 *Inclusionary Housing Policy*

A Social Contract for Rapid Housing Delivery which stated that, “every commercial development including housing developments that are not directed at those earning R1500 or less, spend a minimum of 20% of project value on the construction of affordable housing” was forged between the government and the private sector. This led to the 2007 Framework for Inclusionary Housing Policy (IHP) which aims to achieve a “more balanced outcome of the built environment creation in the direction of a more racially integrated and income inclusive residential environments (Tissington, 2011). With the Town Planning Compliant component, the IHP aimed to ensure that the rapid housing delivery of affordable housing was set off using mandatory requirements and process of land use planning and development such as township establishment procedures, zoning and rezoning development approvals in return for incentives such as density bonuses, allowance for multi-storey units, some commercial rights and public investment in bulk and connector infrastructure. According to Tissington (2011), the inclusionary housing policy has been implemented in metropolitan municipalities like Johannesburg (Cosmo City and Brickfield) and Cape Town (N2 Gateway). Other municipalities have been lagging behind due to a lack of capacity to implement such a complex policy. However, its impact on urban integration and inclusion has remained negligible.

2.6 *The National Housing Code (2009) and Outcome 8 (2010)*

The National Housing Code of 2000, revised in 2009, seeks to improve the coordination and alignment between different planning instruments and economic policies; emphasizing on the need to develop a single planning authority or instrument in order to provide macro level

guidance on the development of sustainable human settlements. The government launched “Outcome 8” in 2010 which aimed to deliver 400,000 upgraded units in informal settlements by 2014 principally by scaling up and reinvigorating existing upgrade programmes (Patel, 2015). It consolidates the policy shift in the revised Housing Code to a focus on informal settlement upgrading and supporting the market to develop affordable housing. With 4 outputs, it reiterates the need for a proper functioning of the land use management system to improve development and zoning processes and systems by fast tracking the development of a new comprehensive land use development and management legislation.

In an attempt to implement the outputs of “Outcome 8”, the government promulgated the Spatial Planning and Land use Management Act, 2013 (Act 16 of 2013) (SPLUMA) after chapters of the DFA were declared unconstitutional and repealed in 2010. Its main objective is to provide a uniform, effective and comprehensive system of spatial planning and land use management. It sets a legal obligation for SDFs to provide an estimation of the housing needs and identification of the planned locations and densities of future housing (Section 21(b) and (c)). A land use scheme must give effect to and be consistent with the SDF and determine the use and development of land within the municipal area. Housing (and its location) is no longer simply a concern of the housing department, as it will be included as part of the municipality’s spatial planning framework (Denoon-Stevens, 2014).

In terms of aligning the housing and spatial planning policies, the DFA was the only post-apartheid legislation that dealt with spatial development principles and provided a land use mechanism; yet, all the housing policies emphasized the importance of spatial planning in the delivery of low income housing. The Housing Act and the housing code stipulated that housing should form an integral part of the IDP at municipal planning level. The link between SDFs and the housing chapter in IDPs has been investigated by Graham *et al.* (2014) in the assessment of whether the existing municipal framework facilitates or hinders integrated planning for sustainable human settlements. Drawing from the case studies of Johannesburg, Buffalo City and eThekweni, Graham *et al.*, (2014) concluded that cities have achieved a level of integration in the long term vision and to a large extent, in the IDP that synthesises the various sector plans into an overall strategy. However, sector plans are still drawn up independently, and the level of integration is determined by the degree to which municipal departments’ liaise with each other. This implies that there are still serious concerns about the alignment of spatial and housing policies. This maybe in vigour of the housing programmes relative to the sluggish planning framework (Charlton and Kihato, 2006) or in the amount of effort required to translate policy sentiments into specific realisable projects (Charlton, 2003).

3 Housing and Planning in Practice: An International Perspective

According to Adams and Tiesdell (2010), the impact of spatial planning is direct in the property development market but indirect in the user and investment markets. This impact operates through three types of policy instruments, intended respectively to shape, regulate and stimulate. Furthermore, the economic interpretations of relations between planning policy and property markets can be viewed through neoclassical economics which asks how far planning policy directly affects the overall quantity of market supply and demand, while welfare economics concentrates on the extent to which planning policy is able to overcome market failure, and new institutional economics focussing on its capacity to reduce (or indeed increase) market transaction costs. In each of these approaches, the market is essentially viewed as dichotomous to planning: open, of course, to influence, but characterised by the unfamiliar terrain of profit-driven behaviour. This implies that any planning system has both benefits and costs. There are direct costs and indirect costs. The direct costs arise from the application of a complex system but more importantly from the costs falling on the private sector in order to comply with the system (Cheshire *et al.*, 2012). The indirect costs arise from the higher costs

of space brought about by the constraint on its supply, and the controls imposed on the choice of location. It is this direct view of costs that planners have that causes a lot of spinoffs in the property industry.

3.1 Availability of land for housing

Internationally, much attention has been paid to the extent to which planning policies make land and property more expensive through constraining supply. Cheshire and Sheppard, 1989; Adams and Watkins, 2002; Meen, 2005 covered the UK, while Maclennan and others (1998) several European countries and Glaeser and Gyourko (2003) the United States. For instance, Glaeser and Gyourko's work was the first where the data permitted fully specified hedonic models to estimate the effects of regulations on the value customers place on the underlying land. Similar, if not less, robust quantitative results on the effect of policy on housing have also been obtained for developing countries. For example, Malpezzi and Mayo (1997) used a simple regression model to compare housing supply elasticities in the Republic of Korea, Malaysia and Thailand to show how various public interventions constrain supply elasticity especially in the Malaysian housing market. They found that interventions such as the provision of publicly constructed housing and inappropriate building and land use standards, cause supply to be considerably less elastic. According to Baken and Van der Linden (1993) in Buckley and Kalarickal (2005), the study ignored political and cultural frameworks within which land markets function. This implies that supply inelasticity is not only caused by the regulations but by the broader policy framework that governs land supply. Buckley and Kalarickal (2005), further argue that the effects of housing policy on the supply of housing has provided empirical support for the view that housing the public sector enable rather than control or displace the private sector. This is essential to improve the affordability of housing in general.

3.2 Affordability

Bramley (1993) argues that the absence of planning cannot solve all the problems of housing supply, even theoretically because housing supply would not be completely elastic. Planning in practice can be quite responsive to the market. For instance, Whitehead (2006) investigates the use of land use planning in providing affordable housing in England. She pointed out that policies to address the issues of how to ensure affordable housing for particular groups arising from the misadministration of income within a market framework include income supplements, targeted price reductions or regulatory mechanism that separates the housing market into two or more segments. Furthermore, land use planning can be used in principle to achieve the goal of lower house prices overall by enabling more land to be provided by using the zoning system which states that particular areas are designated for housing. However, Bramley (1993) highlights concerns about speculative withholding of land by private owners or developers as an issue to the development process.

In investigating the relationship between land use regulation and residential construction, Mayer and Sommerville (2000) characterised regulations either as adding explicit cost, uncertainty or delays to the development process. Using data from 44 United States metropolitan areas, they found that the land use regulations lower the steady state of new construction and the regulations that lengthen the development process or otherwise constrain new development have larger and more significant effects. Cheshire and Sheppard (1989) applied a sophisticated intra-urban model to measure the impact of planning controls and planned amenity provision in a limited number of cities. They concluded that British planning control, by containing urban extension, tends to increase house prices moderately but has its main (adverse) welfare impact in the form of increasing densities and house-type mix. These conclusions are consistent with the qualitative observations of Evans (1991) concerning the

type of housing produced under the relatively tight planning regime which is characteristic of southern England.

4 Impact of Planning on Low Income Housing Development in South Africa

4.1 Constraint to the ability of the poor to acquire and develop land

In investigating the challenges faced by the poor in accessing land and housing, Berrisford *et al.* (2008) cited the inconsistent or inadequate policies and legislation, confusion between myriad agencies involved, lack of clarity over responsibilities and accountability, lack of capacity of the implementing agencies, the rising costs and delays in accessing building materials, corruption and a lack of training for both government officials and housing hopefuls as major challenges experienced in Ethembalethu, Mogale City. Furthermore, they concluded that planning implementation systems are extremely complex and laden with transaction costs, for instance the township establishment process runs parallel to the Environmental Impact Assessment (EIA) process, stifling the capacity of all actors and constraining the ability of the poor to acquire and develop land. Consistent are the conclusions of Kitchin and Ovens (2013) who pointed out the increase in construction and handling costs due to the delays in the application and approval delays. Oranje *et al.* (2010) investigated the perceptions and everyday experiences of developers and municipalities around urban land development. The general perception of the developers in the case study was the cost implications associated with bureaucratic delays.

Kihato and Berrisford (2006) examined the role of regulatory frameworks in the management of urban land in South Africa and how it influences access to land among the urban poor. They cited that regulatory frameworks are intended to protect and enhance an investment, for instance zoning and other regulations that prevent uses of land that negatively affect property values. Furthermore, regulatory laws are too technocratic and highly procedural thereby hindering the activities on land like densification. Also consistent are the conclusions of Rubin (2008) in his study of the contemporary land use management systems and their operation at both policy and practical level who concluded that the existing planning schemes, zonings and the cadastral system are in many ways exclusive of the needs of low-income households and communities and seem to result in the disempowerment and alienation of those that they intend to include and empower. By initiating a search for an appropriate criterion for land use management system in South Africa, Görgens and Denoon-Stevens (2012) characterised the traditional land use management system as zoning emphatic and argue for a more flexible system that responds to the dynamics of the urban land market and directly addresses the needs of the poor.

4.2 Affordability

Zille *et al.* (2008) conducted a qualitative analysis on the dynamics of urban land markets in South Africa. They argue that restrictive town planning regulations and an inflexible institutional environment limit the supply of land, increases development risk, raises the price of land and therefore impacts on development activity. They further argue that planning regulations alter land prices, for instance, a decision by public authorities to bring public land to the market may also alter land availability and price of land- as supply increases, so the price will drop. Napier *et al.* (2007) discusses the balance between state allocation of urban land and market distribution of land as a resource. He noted that the outcome of the distortions is that house prices at the upper end of the market have seen unprecedented growth, while low income house owners have not benefited from the same growth. This implies that while there is little research on the tradable values of subsidised housing, it is widely understood that there has

been substantial depreciation in formal sales. It is clear that the house prices in low income housing developments are not at par with their counterparts in affluent areas because of the location, neighbourhood influences and access to bank loans. Low income housing developments are stagnant, non-active housing markets where investors make losses, getting no return for their investments. These problems having been created partially by planning mechanisms and can be addressed by proper planning. It is at this stage that Adams & Tiesdell (2010)'s call for planners to see themselves as market actors intricately involved in framing and reframing local and property markets, hence operating as a significant constitutive element of such markets becomes relevant.

5 Gaps in the Literature and Implications for Research

In the literature review, housing policies (BNG, IHP, and housing code) highlighted the importance of spatial planning in the delivery of low income housing and the need to incorporate the housing chapter in the municipal IDPs in a bid to align housing delivery and spatial planning. None of these studies have followed up on the link between housing policies and spatial planning, whether the spatial planning aspects highlighted in the housing policies have been incorporated in the planning tools and used in practice.

The Inclusionary Housing Policy introduced the use of incentives such as density bonuses and allowance for multi storey units to ensure the rapid delivery of affordable houses. There is need for further research in incorporating the housing concepts highlighted in the BNG and IHP into the land use management tools such as integrated development plans, spatial development frameworks and zoning schemes in order to develop a framework to deliver low income housing through the planning system.

6 Conclusion

The aim of the paper is to examine the relationship between planning and low income housing development in South Africa, investigate the extent to which the planning system is aligned to the low income housing policies and evaluating whether planning regulations enable or constrain the provision of low income housing. The study concludes there is relationship between planning and the availability and affordability of housing yet such relationship has not been well articulated in low income housing developments. However, the complex approach to housing delivery relies on the implementation of policy and legislative frameworks for both planning and housing across different spheres of government. Moreover both housing and planning officials should be empowered to handle the planning and delivery of housing in a holistic manner.

7 References

- Adams, D and Tiesdell, S (2010). Planners as market actors: Rethinking state-market relations in land and property. *Planning Theory & Practice*, Vol. 11 (No.2), pp. 187-207.
- Adams, D and Watkins, C (2002). *Greenfields, Brownfield's and Housing Development: Real Estate Issues*. United Kingdom: Blackwell Publishing.
- Beer, A, Kearins, B and Pieters, H (2007). Housing Affordability and Planning in Australia: The challenge of policy under neo-liberalism. *Housing Studies*, Vol. 22 (No.1), pp. 11-24
- Berrisford, S (2011). Unravelling apartheid spatial planning legislation in South Africa. *Urban Forum*, Vol. 22 (No.3), pp. 247-263.
- Berrisford, S, De Groot, D, Kihato, M, Marrengane, N, Mhlanga, Z and Van den Brink, R (2008). In Search of Land and Housing in the New South Africa: The Case of Ethembaletu. *The International Bank for Reconstruction and Development/ THE WORLD BANK*, World Bank Working Paper (No. 130).

- Bramley, G (1993). Land use planning and the housing market in Britain: the impact on housebuilding and house prices. *Environment and Planning*, Vol. 25, pp. 1021-1051
- Buckley, R and Kalarickal, J (2005). Housing policy in developing countries: Conjectures and refutations. *The International Bank for Reconstruction and Development/THE WORLD BANK*, Oxford University Press
- Charlton, S (2012). The state of land use management in South Africa. *Urban Landmark*.
- Charlton, S and Kihato, C (2006). Reaching the Poor: An analysis of the influences on the evolution of South Africa's housing programme. In: Pillay, U, Tomlinson, R & du Toit, J, *Democracy and Delivery: Urban Policy in South Africa*, HSRC Press, pp. 252-282
- Cheshire, P and Sheppard, S (2002). The welfare economics of land use planning. *Journal of Urban economics*. Vol. 52, pp. 242-269
- Cheshire, P and Sheppard, S (1989). British planning policy and access to housing: some empirical estimates. *Urban Studies*. Vol. 26, pp. 469-485
- Denoon- Stevens, S (2014). The Role of Land Management in Shaping (or Preventing) the Creation of Sustainable Human Settlements. In: South African Cities Network, *From Housing to Human Settlements: Evolving Perspectives*, Johannesburg.
- Du Plessis, D (2013). A Critical Reflection on Urban Spatial Planning Practices and Outcomes in Post-Apartheid South Africa. *Urban Forum*, Vol. 2014 (No. 25), pp. 69-88.
- Evans, A.W (2004). *Economics and Land Use Planning*. Oxford: Blackwell
- Graham, N, Jooste, M and Palmer, I (2014). The Municipal Planning Framework. In: SACN, *From Housing to Human Settlements: Evolving Perspectives*, Johannesburg.
- Görgens, T and Denoon-Stevens, S (2012). Towards Facilitative and Pro-poor Land-Use Management in South African Urban Areas: Learning from International Experience. *Urban Forum*, Vol. 24, pp. 85-103
- Huchzermeyer, M (2003). Housing rights in South Africa: Invasions, evictions, the media and the courts in cases of Grootboom, Alexandra and Bredell. *Urban Forum*, Vol. 14 (No.1)
- Jenkins, P (1999). Difficulties encountered in community involvement in delivery under the new South African Housing Policy. *Habitat International*, Vol. 23 (No.4) pp. 431
- Khan, F and Thurman, S (2001). Setting the stage: Current housing policy and debate in South Africa. *Isandla Institute*
- Kitchin, F and Ovens, W (2013). Land Governance in South Africa: Implementing the Land Governance Assessment Framework. *Urban Landmark*.
- Kihato, M and Berrisford, S (2006). Regulatory systems and making urban land markets work for the poor in South Africa, *Urban Land Mark*, Position Paper 4.
- Musvoto, G (2011). Towards a framework for assessing settlements patterns and trends in South Africa to guide sustainable settlement development planning. A case of KwaZulu Natal Province. *Doctoral Dissertation*. Faculty of Humanities, Development and Social Sciences, University of Natal
- Napier, M (2007). Making Urban Land Markets work better in South African cities and towns: Arguing the basis for access by the poor. Urban land markets programme, *Fourth Urban Research Symposium*, 2007
- Napier, M and Ntombela, N (2007). Towards effective state interventions to improve access by the poor to urban land markets. *CSIR*
- Newton, C and Schuermans, N (2013). More than twenty years after the repeal of the Group Areas Act: Housing, spatial planning and urban development in post-apartheid South Africa. *J House and the Built Environ*. Vol.28, pp.579-587.
- Patel, K (2015). Sowing the seeds of conflict? Low income housing delivery, community participation and inclusive citizenship in South Africa. *Urban Studies*, Special Issue, pp. 1-20.

- Rubin, M (2008). Land management and democratic governance in the city of Johannesburg: Synthesis report. *Centre for Urban and Environmental Studies*
- Seekings, J (2000). Introduction: Urban Studies in South Africa after Apartheid. *International Journal of Urban and Regional Research*. Vol. 24 (No.4).
- Sishaka Development Management Services (2011). Housing Subsidy Assets- Exploring the Performance of Government Subsidised Housing in South Africa: Timeline Analysis. *Finmark Trust*.
- Tissington, K (2011). A Resource Guide to Housing in South Africa 1994-2010: Legislation, Policy, Programmes and Practice. *Social Economic Rights Institute of South Africa*.
- Todes, A (2003). Housing, integrated urban development and the compact city. In: Harrison, P, Huchzermeyer, M & Mayekiso, M. *Confronting fragmentation: Housing and urban development in a democratising society*. Cape Town, Juta, pp. 109-121
- Venter, C, Biermann, S and Ryneveld, M (2004). Low cost housing location in South African cities: Empirical findings on costs and benefits. *Proceedings of the 23rd Southern African Transport Conference*, 12-15 July 2004, Pretoria, pp. 563-574.
- Whitehead, C (2006). Planning Policies and Affordable Housing: England as a Successful Case Study? *Housing Studies*, Vol. 22 (No.1), pp. 25-44.
- Zille, P, Viruly, F, Tomlinson, M, Hobden, T, Erasmus, M (2008). The dynamics of the formal urban land market in South Africa. *Urban Landmark*.

Construction Trends in Strategic Management

WORKERS’ SAFETY ON CONSTRUCTION SITES: USE OF PPEs IN LESOTHO

Emuze, Fidelis; Khetheng, Alice

Department of Built Environment, Central University of Technology, Free State, Bloemfontein, Free State, South Africa

Abstract

This paper presents the findings of a study that focus on the safety of construction workers. The study explored the poor use of personal protective equipment (PPE) by construction workers in Lesotho. The aim of the study was to identify and assess the causes of poor usage of PPE on project sites in Lesotho in order to suggest practical solutions to them. The primary data for the study were collected through direct site observations and face-to-face interviews with construction workers and their site managers in Lesotho. Given that textual data do not lend itself to statistical analysis, thematic analysis was used for producing the results of the study. The study reveals that inadequate enforcement of regulations, unfounded attitude towards H&S and non-availability of PPE forms the major reasons for their poor usage by workers on project sites. These imply that inspection functions related to regulations must be addressed while contracting parties should see investment in PPE as money spent wisely for the business. In other words, PPE can prevent injury and fatalities on construction sites of workerds, as it is evident from practice that its optimum usage is crucial to saving workers in the event of an accident during construction.

Keywords: Construction, Health and Safety, Workers, Lesotho

1 Introduction

The construction industry in the global context has a poor health and safety (H&S) record and Lesotho is no exception. The construction industry has been closely linked to the economy of a country and is often a good indicator of the state of an economy (James et al., 2012). This is also applicable in Lesotho where the construction industry is an important player in the economy and in spite of the numerous constraints facing the industry in developing countries; it makes significant contributions and plays a vital role to economic growth. The construction industry is a challenging environment to work in, and the industry has been associated with high risks where workers are exposed to tough and hazardous situations. For example, workers have to work with dangerous tools, plants and equipment on a daily basis and as a result every construction worker is likely to be temporarily unfit to work at some stage in their life as a result of moderate injuries or health problems caused by working on a construction site.

Although industrialisation and advances in technology in recent decades have made inroads into the construction industry, the industry is still very much dependent on human resources to perform the physical work required on a construction site. It is therefore imperative that the health and safety (H&S) of workers are taken into consideration. This consideration will be beneficial as it will save the employer a lot of time and money that would have been spend managing an accident that occurred due to poor H&S on site. If the construction industry and the economy of a country are so closely linked, then it makes economic sense to care for the

people active in the industry (Dainty et al., 2007). It should also be noted that the cost of managing accidents is higher than the cost of prevention; therefore H&S should be viewed as a profit centre by contractors and their employers (Smallwood, 2004).

The international construction management literature also alludes to the fact that H&S is part of employers' legal, moral and management obligation because it is an investment, a cost saver, and productivity promoter (Reese, 2008). From a business point of view, accidents affect the bottom line of projects since the economic impacts of site accidents add direct and indirect costs to projects. In fact, the construction H&S literature is full of evidences that finger management failure is a major cause of injuries and accidents in the workplace (Choudhry and Fang, 2008). The lack of PPEs at work can be likened to be a form of management failure, which engenders workplace fatalities, injuries and diseases (Cavazza and Serpe, 2009). In the context of this research, management failure pertains to either non issuance of required PPE to workers or non-enforcement of the use of the PPE by workers. The problem statement of the research is therefore predicated on evident poor use of PPEs by workers on construction project sites in Lesotho, especially in Maseru. To unravel the problem, three questions were used to drive the research. The questions include:

- What is the attitude of employers towards the Health and Safety (H&S) of construction workers in Lesotho?
- Why do construction workers in Lesotho proceed with construction site activities without the required Personal Protective Equipment (PPE)?
- What role should clients and the government in Lesotho play to ensure that construction workers' H&S are not compromised?

2 Literature Review

Occupational H&S is neglected in sub-Saharan Africa (Puplampu and Quartey, 2012) where H&S performance appears to be poorer in comparison to developed countries (International Labour Organization (ILO), 2003). This view is partly because of the lack of resources in developing countries that has constrained H&S performance (Kheni et al., 2007) and this is obvious in sub-Saharan Africa where Lesotho is located. In addition, the inadequate legal and institutional arrangements for management of H&S have compounded the problem of H&S performance in developing countries (Kheni et al., 2007). Other contributors to poor H&S performance include a lack of effective mechanisms to implement legislation and regulations (Alkilani et al., 2013), the lack of infrastructure, equipment and rampant corruption and lack of concerted effort by policy makers to address H&S (Kheni et al., 2007). In addition, the industry is also labour intensive and utilises people for physical conversion processes on site even for tasks that may be hazardous (ILO, 2005). The industry in developing countries is dominated by small and medium contractors and most of these do not have effective systems to manage H&S (Kheni et al., 2007). Protecting people through PPEs is therefore mandatory on project sites.

2.1 Personal Protective Equipment

PPE refers to protective clothing, helmets, goggles, or other garment or equipment designed to protect a construction worker's body from injury by blunt impacts, electrical hazards, heat, chemical hazards, and infections. In South Africa, the construction regulations (2003) urge the use of PPEs to reduce employees' exposure to hazards where administrative controls are not feasible or effective in reducing these exposures to acceptable levels (Republic of South Africa, 2003). To ensure a safe and effective use of PPE by employees, a PPE programme should be designed and implemented. The implementation will always elicit reactions from workers who are directly involved in physical work on sites. The reaction of workers to unsafe working

conditions is however dependent on whether they identify the condition as “unsafe” or not. Hosseinian and Torghabeh (2012) summarise the issues as:

- The worker does not identify the unsafe condition; therefore there is no risk and hazard consideration by the worker. Some unsafe conditions cannot be identified such as non-human-related conditions or human factors violation. Human factors violation may lead to injuries namely cumulative trauma disorders, carpal tunnel syndrome, fatigue and overexertion.
- The worker identifies the unsafe condition and recognizes the related hazards; the reaction might be ‘safe act’ meaning one would quit the task until the unsafe condition is modified or one could disregard the unsafe condition and continue the task (unsafe act). The reasons of failure to identify unsafe conditions and also the reasons that worker continue the task after identification of unsafe condition should be investigated by management.

H&S climate also affect the use of PPEs by workers (Cavazza and Serpe, 2009). Please see Cooper (2001) for a discussion on H&S climate in relation to organisational systems, leadership, risk control systems, H&S auditing, training and behaviour in the workplace. Cavazza and Serpe (2009) observe that organisational H&S concern, senior managers’ H&S concern, and supervisors’ attitudes towards H&S tend to be positively associated with the individual ambivalence level in terms of the use of PPE. In brief, the poor use of PPEs is indicative of the elements of poor management of construction H&S (Tam et al., 2004).

2.2 Attitudes towards Construction Health and Safety

Despite efforts to effectively prevent and control the cause of accidents in the construction industry, the problem of H&S in the industry is still a cause of great concern (Health and Safety Executive (HSE), 2003). Much of this concern can be minimised with the active involvement of the client, which will ultimately result in less incidents and accidents on site. Enshassi and Mayer (2004) state that if construction sites are to become safer, the major task is to change people’s attitude. In practise, for example, not all clients pay great attention to H&S management because of other business objectives such as profitability, schedule and quality (Zeng et al. 2004). Issues of H&S are rarely addressed by owners, engineers and contractors during the construction planning and execution processes (Rowlinson, 2004).

Thus, striving for enhanced H&S performance in Lesotho will remain elusive if the client is not actively involved in solutions. Huang and Hinze (2006) argue that the involvement of clients or owners is an essential requirement for the achievement of the zero harm goals. Other researchers have also recognised the importance of the client in the management of H&S. Suraji et al. (2001) noted that construction H&S can be successfully influenced by clients. To emphasise the point that clients are very important in the management of H&S, Suraji et al. (2001) argue in their paper on accident causation that construction accidents are caused by inappropriate responses to certain constraints in the environment. They observed for example that the client responses are the actions or failure to act in response to constraints that emerge during the development of a project. According to them, these include reducing the project budget, adding new project criteria, changing project objectives and accelerating the design or construction efforts of the project. These perceptions are reinforced by clients who abdicate their roles and put on H&S responsibilities on contractors.

Increasing research findings are beginning to highlight the gaps in enforcements (Geminiani and Smallwood, 2008). In essence, regulations alone are not a panacea in dealing with the challenges of H&S in the construction industry. Trained manpower also has a role to play in dealing with the matter. At the moment, anecdotal evidence suggests that there is a competency deficit in the sector in Lesotho. Most contractors do not have trained personnel who understand

the complexity of issues on the construction site and are able to come up with interventions. Though it would be unfair to paint all contractors with one brush, as some contractors may have employed competent H&S practitioners and the situation of those contractors would be better than those who do not have competent practitioners; contractors that lack competent H&S practitioners are the ones that have high potential to accommodate failures. It would also be good for the economy of Lesotho, if contractors whose H&S performance is poor learn from best practices. One of such best practice is the provision of required PPEs for workers on project sites.

Nevertheless, a proactive management of H&S requires the use of an approach that is not dependent on the monitoring of injuries after they occur (lagging indicators of performance) (Hinze, 2005). Rather than basing H&S actions on measures of failure, a shift in thinking is needed whereby the focus is on actions that can lead to good H&S performance (leading indicators of performance) (Hinze, 2005). The attitude of leaders plays an important role in cultivating a good H&S culture. As an illustration, a good leader will ensure that workers have all required protections in the form of PPEs while working on site.

3 Research Methodology

Qualitative research explores the attitudes, behaviour and experiences through interviews and focus groups. It aims to obtain rich perceptions from participants. As it is attitudes, behaviour and experiences which are important, fewer people take part in the research, but the contact with people yields expected rich data (Ritchie et al., 2014). Moreover, qualitative research focuses on meaning, language and cultural experiences in social context. This approach is concerned with understanding particular situations, rather than generalizing findings, so the method used in this study is analyses of interviews, and recorded observations (Thomas, 2011). Thus, face-to-face interviews that were preceded by on site observations were used to collect the responses to the research questions. Site observation is necessary to visually establish how construction workers use PPEs on site in Lesotho. Although pictures were prohibited in the sites, the researcher was able to identify poor use of PPEs on the selected sites and several other sites visited in 2014. Figure 1 is indicative of the extent of the problem in Lesotho. The picture was taken on a construction site in Maseru, Lesotho. The picture is one of the random construction site pictures obtained for the study. The interviewees include 12 construction workers in four project sites, four contractors in charge of the four project sites, and a representative of the Department of Labour (DoL) in Maseru, Lesotho. The interviewees were therefore 17 and for a qualitative study, the number is reported to be enough for data analysis (Thomas, 2011). In conformance to qualitative research tradition, the interviewees were purposively selected by visiting construction sites in which work activities were on going in Maseru (Tracy, 2013). The 17 interviewees were asked 10 open ended questions with the use of a protocol that was designed based on the research questions presented in section 1. The interview protocol is enclosed as annexure 1 at the end of this paper. The length of industry exposure of the interviewees ranges from 2 to 44 years. The interviewees hold certificates, diplomas and degree qualifications, and they were all fluent in the use of English Language, which makes the interviews less problematic. The textual data from the interviews were analysed thematically as shown in the discussion of the findings in section four of this paper.

4 Findings and Discussion

As mentioned earlier, interview data were collected and the analysis of the data provides the basis for the results in this section. The perceptions of the interviewees concerning the PPE issues are herein discussed in the next sub sections.



Figure 1. Illustration of poor use of PPEs in Lesotho construction (Source: Authors)

4.1 Attitude towards construction H&S in Lesotho

In response to questions related to the above mentioned theme, the interviewees from the DoL confirm that construction H&S is a priority in Lesotho as there are regulations that mandate stakeholders to fulfil their responsibilities. For example, he noted that employers have to advocate for optimum H&S compliance when appointing contractors. This employer interest motivates the contractors to exercise H&S effectively. The interviewed contractors also commented on the theme. According to the contractors in Lesotho the attitude of the employers regarding H&S are positive, this can be witnessed by the H&S practices that are carried out. As a good practice, the contractors mentioned the induction that is done for every worker regardless of their time in construction industry, as all sites are different and have a wide range of hazards that change as the site develops. They emphasised that every site has a specific induction and provides information on the current hazards of the site and provides the site rules. The inductions facilitate the type and use of PPEs on sites. The contractors also highlight that the DoL takes interest in how inductions are conducted on project sites.

It is however notable that the response of the interviewed workers is at variance with that of the contractors. The workers response regarding the attitude of employers is that employers do not care about their safety as they do not always go on site to check if the contractor exercises H&S according to the H&S plan that the contractor presented to the client. So the contractors take the advantage of safety of the workers because they are aware that follow ups are made infrequently or not even made at all. The workers says that there are some instances when safety officers are not on site, yet the regulations clearly state that there should always be H&S officer to check the workers processes to ensure they follow safety precautions. The workers confirm that inductions have to be made regularly irrespective of whether workers are newly employed or already have experience in construction as every project is unique. Every induction is specific to its site; it provides relevant information on the current hazards and informs workers on the rules for the specific site. It therefore inform on the type of PPE to be used by workers on each site. In brief, the interviewed workers say that in Lesotho inductions are not always done.

4.2 Possible reasons for poor use of PPEs in Lesotho

In response to poor use of PPE, the DoL representative says that it is not possible for workers to work on site without proper PPE as the contractors are aware of the consequences they face if they do not make it a point that PPE is available for workers. Moreover the DoL representative added that due to the fact that H&S officers are always on site, it is not easy for workers to work unprotected. This perception of the DoL representative clearly differs from that of the interviewed worker.

When the interviewed contractors were requested to comment of the poor use of PPE, they all agreed that PPE is required and compliance is mandatory. Although one interview flag gaps in the compliance aspect, he was of the opinion that PPE should be a compelling factor in terms of conditions of tender and supervising engineers should not permit work without it. The interviewee further says that inspections by the DoL should endeavour to close the compliance gaps. Even on-site audits by contractors should also be used by contractors to see where gaps lie. In their responses, most workers mention that PPE is not a standard measure as mentioned by the contractors because if it happens that they provide full PPE to the workers on arrival they do not make replacements when the PPE is no longer in good conditions. It is not possible for H&S officers to check workers' H&S compliance as they are not always present on construction sites. This is another gap that negates the intent of compliance. In the workers opinion with regards to compliance in terms of PPE use, the regulating bodies should have regular audits or inspections to check the construction sites, H&S officers should conduct toolbox talks on site to make workers aware of the risks involved in construction activities. It is important to note that PPE use cannot be compromised.

4.3 The role of the regulator of construction H&S in Lesotho

In Lesotho there are regulations that are solely government responsibilities to implement in the construction industry. Moreover the government responsibility through DoL organises inspections on construction sites to make a follow up on rules and regulations compliances. For non-compliant contractors, the group of DoL in inspection process draw up the report and give warning to the contractor and allow the contractor some time to rectify the mistakes observed, when the regulatory bodies come to make a follow up and find the situation to not be rectified, the contractor is taken to the courts of law. Clients in Lesotho are forced by law to take H&S as an important factor when choosing a competent contractor to carry out their projects. Clients when choosing the contractor look at their H&S plans and their reputation in H&S matters. This mechanism is in place so that clients do not award tenders to contractors with a bad reputation in H&S. The interviewed contractors confirm the response of the DoL representative. They opine that as required by law, clients are required to take a major role in construction H&S. In Lesotho the government sets the regulations and the clients ensure that the contractors are executing their work according to the regulations. Clients initiate this process by awarding the contract to the contractor with a good H&S plan, workers compensation insurance cover, and evidence of good reputation in H&S matters. Moreover, the interviewees note that the DoL ensures construction workers H&S by setting regulations and organising site inspections to ensure compliance by contractors.

The analysis of the responses from the workers show that they agree that there are regulations in Lesotho that are said to be governing the construction sector, but there is nothing done by the government to ensure compliance. There are workers who agree that the inspectors from the DoL do conduct inspections while others say they do not. If the main issue is to strive for zero accidents in construction all the on-going construction sites should be checked. On the part of the client, the workers say it seems in most cases clients do not take initiative in relation to H&S issues. According to them, this is why contractors take advantage of workers by not ensuring the good working conditions in terms of PPEs.

5 Conclusion and Further Research

Construction work on various sites is not only people intensive, but it could also be highly dangerous. Completion of tasks without the usage of required PPEs is not in the interest of workers, their employers, and the industry. This exploratory Lesotho study that focus on PPEs provides answers to the research questions of section 1 by pinpointing the reasons for poor use of PPEs in Lesotho through the perceived attitudes of employers in the construction industry. The study also flags the role of the DoL in this context. As illustrated in section 4, the interviewed workers are concerned about matters related to attitudes towards construction H&S in Lesotho. Whereas the DoL representative portrays the image that all is well, the contractors noted compliance gaps and the workers were unanimous about implementation and enforcement gaps. The study reveals that construction workers in Lesotho may proceed with construction site activities without the required PPEs due to either limited or total lack of requisite site inductions and inadequate H&S site supervision – no H&S officer on site.

These perceptions indicate that the government of Lesotho through the DoL should play a more active role to ensure compliance. When the responses from the DoL representative is reflected upon, one arrive at a conclusion that there are disconnections / misalignments between what is happening on various construction site as attested by the workers and what the regulator view as the status quo in Maseru, Lesotho. It is therefore suggested that:

- The government should establish a system to allow for constant monitoring and evaluation of the steady and careful application of the regulations by DoL officers to ensure that duties are executed with due diligence.
- The DoL should also ensure that a competent person inspects construction project sites at suitable and regular intervals to ensure complete compliance.
- Clients should improve their interest in H&S and appoint contractors that provide proper programmes that are consistent with national regulations to ensure the H&S of workers, especially in relation to PPEs.
- Employers and contractors should explore the costs for PPE measures and explicitly include it as part of tendering and costing for project execution.
- Contractors should ensure that PPEs are checked at regular intervals to ensure that they remain fit for purpose and site supervisors should not abdicate their H&S role by allowing the execution of work on site by workers that do not make use of required PPE.
- Workers should also wear PPE properly either as directed by their employer or in compliance with the instructions of the person in control of the construction site.
- Worker should also take care of the equipment; refrain from misuse of the equipment and most importantly, report defects and problems to their supervisors.
- Workers at a construction site have a right to proper information regarding their safety before they start of on a project. This information should be obtainable in a language that they can understand. In other words, inductions as mandated by the law must be properly conducted on project sites and it must include the basics such as the compulsory usage of PPEs.

6 References

- Alkilani, S.Z., Jupp, J. and Sawhney, A. (2013) Issues of construction health and safety in developing countries: a case of Jordan. *Australasian Journal of Construction Economics and Building*, Vol. 13(3), pp. 141-156.
- Cavazza, N. and Serpe, A. (2009) Effects of safety climate on safety norm violations: exploring the mediating role of attitudinal ambivalence toward personal protective equipment. *Journal of Safety Research*, Vol. 40(4), pp. 277-283.
- Choudhry, R.M and Fang, D. (2008) Why operative engage in unsafe work behavior: investigating factors on construction sites. *Safety Science*, Vol. 46(4), pp. 566-584.
- Cooper, D. (2001) *Improving safety culture: a practical guide*. Hull, Applied Behavioural Sciences.
- Dainty, A.R.J., Green, S. and Bagilhole, B. (2007) *People and Culture in Construction: A Reader*, London, Spon Press.
- Enshassi, A and Mayer, E (2004). *Analysis of construction site injuries in Palestine*. In: S Rowlinson (ed.) *Construction safety management systems*, London, Spon Press, pp. 73-80.
- Geminiani, F. & Smallwood, J. (2008) A critical review of the effectiveness of the Department of Labour (DoL) Occupational Health and Safety(OH&S) Inspectorate in relation to the construction industry in South Africa. *Acta Structilia*, Vol. 15(2), pp. 1-28.
- Health and Safety Executive (2003) *Causal factors in construction accidents*. Research report 156, Norwich, HSE.
- Hinze, J. 2005. *A paradigm shift: leading to safety*. In: Haupt, T.C and Smallwood, J.J. Eds. *Rethinking and Revitalising Construction Health Safety, Environment and Quality*, Port Elizabeth, 17-20 May. Walmer.
- Hosseinian, S.S. and Torghabeh, Z.J. (2012) Major theories of construction accidents causation models. *International Journal of Advances in Engineering & Technology*, Vol. 4(2), pp. 53-66.
- Huang, X. and Hinze, J. 2006. Owner's role in construction Safety: guidance model. *Journal of Construction Engineering and Management*, Vol. 132(2), pp.174-181.
- James, P.M., Rust, A.A.B. and Kingma L. (2012). The wellbeing of workers in the South African construction industry: A model for employment assistance. *African Journal of Business Management*, Vol. 6(4), pp.1553-1558
- International Labour Organization (2003). *Safety in Numbers: Pointers for a Global Safety Culture at Work*. Geneva, Switzerland.
- International Labour Organization (2005). *Number of Work related Accidents and Illnesses Continues to Increase*. ILO/WHO Joint Press Release. Bank Regions.
- Kheni, N.A., Dainty, A.R.J. and Gibb, A.G.F. (2007). Influence of political and socio- cultural environments on health and safety management within SMEs: a Ghana case study. In: Boyd D (Ed) *Proceedings of the 23rd Annual ARCOM Conference*, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management, 159-168.
- Puplampu, B.B. and Quartey, S.H. 2012. Key issues on occupational health and safety practices in Ghana: a review. *International Journal of Business and Social Science*, Vol. 3(19), pp. 151-156.
- Reese, C.D. (2008) *Occupational health and safety management: a practical approach*. 2nd ed. Boca Raton, CRC Press.
- Republic of South Africa (2003) *Construction Regulations*. Government Gazette No. 20095. Pretoria: RSA.
- Ritchie, J., Lewis, J., Nicholls, C.M. & Ormston, R. (2014) *Qualitative research practice: a guide for social science students and researchers*. 2 ed. London, Sage.
- Rowlinson. S. (ed.) (2004) *Construction safety management systems*, London, Spon Press.

- Smallwood, J.J. (2004). The influence of clients on contractor health and safety (H&S). In: Khosrowshahi, F (Ed.), *20th Annual ARCOM Conference*, 1-3 September 2004, Heriot Watt University. Association of Researchers in Construction Management, Vol. 2, 1095-105.
- Suraji, A., Duff, R.A., and Peckitt, J.S., 2001. Development of causal model of construction accident causation. *Journal of Construction Engineering and Management*, Vol. 127(4), pp. 344-34
- Tam, C.M., Zeng, S.X. and Deng, Z.M. (2004) Identifying elements of poor construction safety management in China. *Safety Science*, Vol. 42(7), pp. 569-586.
- Thomas, G. (2011) *How to do Your Case Study: A guide for students & Researchers*. London, Sage.
- Tracy, S.J. 2013. *Qualitative research methods: collecting evidence, crafting analysis, communicating impact*. Chichester, Wiley-Blackwell.
- Zeng, S.X., Tam, C.M. and Deng, Z.M (2004). *Construction site safety in China*. In: S Rowlinson (ed.) *Construction safety management systems*, London, Spon Press, pp. 49-66.

Annexure 1 - The Interview Protocol

Part 1: What is the attitude of employers to the H&S of construction workers in Lesotho?

1. Is H&S a priority in construction projects in Lesotho?
2. Is there a health and safety officer always on project sites?
3. Are the workers inducted for health and safety purposes on project sites?
4. Who is responsible and accountable for health and safety on project sites in Lesotho?

Part 2: Why do construction workers proceed with site activities without required personal protective equipment (PPE) in Lesotho?

1. Is PPE a standard measure for H&S on construction projects in Lesotho?
2. Does the health and safety officer ensure compliance in terms of the usage of required PPE on project sites in Lesotho?
3. Based on your experience in Lesotho, what can be done to control or assure compliance in terms of PPE use on project sites?

Part 3: What role should clients and the government in Lesotho play to ensure that construction workers' H&S are not compromised?

1. What are the contributions of the various government structures with regard to health and safety compliance on project sites in Lesotho?
2. As a major client of the construction industry, to what extent has the government of Lesotho worked to limit exposure of workers to health and safety hazards in the sector?
3. Do the inspectors from government departments check the extent of compliance with health and safety on construction projects?

FACTORS THAT INFLUENCE REAL ESTATE PROJECT INVESTMENT: PROFESSIONALS’ STANDPOINT

Abidoye, Rotimi Boluwatife; Chan, Albert P. C.

Department of Building and Real Estate, The Hong Kong Polytechnic University, Kowloon, Hong Kong
Oshodi, Olalekan Shamsideen

Department of Architecture and Civil Engineering, City University of Hong Kong, Hong Kong

Abstract

Studies have shown that a number of significant factors influence property value in different real estate markets around the world. These factors affect real estate stakeholders’ decisions and the economy in general. Due to the uniqueness and heterogeneous nature of the property market, this study aims at identifying and examining the significant factors that influence property value adopting Lagos, Nigeria, as a representative case. This study was carried out in two phases. First, a systematic review of studies focused on factors affecting property value in Lagos, Nigeria and other real estate around the world was conducted. Twenty factors which are peculiar to the study area were identified from the review and used to design the survey instrument. The questionnaire was administered electronically to experienced real estate professionals practicing in the Lagos metropolis property market selected from the 2014 membership directory of Nigerian Institution of Estate Surveyors and Valuers (NIESV). The professionals ranked the factors in the order of significance based on their perception. The data collected was analysed to establish the mean score of each attribute which signifies their relative importance to property value determination. Out of the 20 identified attributes, only six are highly significant to real estate investment value in the Lagos metropolis. They include location, neighbourhood characteristics, property state of repair, property size, and level of security in the neighbourhood and age of property. These highly significant attributes when accorded outmost consideration by all real estate stakeholders when embarking on property investment in the study area, will yield profit maximization.

Keywords: Lagos metropolis, Nigeria, Property attributes, Real estate investment, Valuers

1 Introduction

The importance attached to real estate properties by different property market participants cannot be overemphasized. This is because of the contribution of real estate properties to the economy of a nation as well as the wealth of an investor (individual or corporate) and also serve as an edge against inflation. Real estate property can be held as an investment goods and as consumption (i.e. owner-occupier) (Chin and Chau, 2002). The composition of numerous unique characteristics embedded in a real estate property is responsible for the complex nature of this class of investment (Rosen, 1974; Sirmans et al., 2005). To buttress this, Tse and Love (2000), Mbachu and Lenono (2005), Selim (2008), amongst others have conducted studies in different real estate markets and found that the value of a real estate property is determined by a bundle of independent variables and this complexity affects the value attached to each variable by different stakeholders.

Since the products of the construction industry is largely consumed by the real estate sector (Mbachu, 2003), consequently, assessing the factors that affect this class of investment from the viewpoint of real estate professionals that are knowledgeable about the homebuyers' demand (taste and preference) is appropriate. Therefore, the intuitive knowledge of the property market of an experienced real estate valuer should not be ignored in real estate related investments (Aluko, 2007). In other words, valuers' judgement on the significance of the property characteristics is noteworthy and all stakeholders (existing and stakeholders) should consider this when making real estate investments decisions.

Studies (Ajide and Kareem, 2010; Aluko, 2011; Babawale et al., 2012; Famuyiwa and Babawale, 2014) carried out in Lagos, Nigeria, posited that the attributes that determines the value of a real estate property can be estimated using the 'scientific' approach, whereas, the process of property valuation involves both 'art' and 'science' (Azmi et al., 2013). Besides, the results of these studies may be untenable when a critical event occurs (Rosenhead, 1989), for instance, the global economic meltdown. Hence, a different approach is being adopted in this study, which aims to evaluate valuers' judgement on the significance and importance of property attributes that influence the value attached to real estate property investments in the Lagos metropolis.

This study concurrently identifies from literature and evaluates the variables that influence real estate investment project in Nigeria's megacity. The findings of this current research will be useful to all built environment professionals, academics as well as real estate investors, it will provide an overview of the most significant factors that should be considered when investing in the Lagos metropolis. The next section of this paper presents an overview of property value determinants followed by the presentation of the methodology adopted for the research. The following section presents the results and discussion, while the conclusion and further research is presented in last section.

2 Property Value Determinants – Review of Literature

Different studies have been conducted by scholars in real estate markets around the world to establish the peculiar attributes that influence real estate investments in their property markets. The need for market specific studies could be attributed to the differences in the cultural, legal, financial and economic setting of each country (Olayiwola et al., 2005), which makes the value of real estate investment to be influenced by location, location, location (Li et al., 2011).

In order to develop a comprehensive list of attributes that influence real estate property investments in the Lagos metropolis, the determinants of property value in the Lagos metropolis were identified from published articles retrieved from online databases and search engines and were reviewed. A total of 20 independent attributes were found to be significant in the studies retrieved for review (see Table 1). Table 1 shows that the 'availability of neighbourhood security' is a reoccurring theme in six out of the seven studies focused on the Lagos metropolis property market. It is reasonable to suggest that this variable is the most significant factor determining property value in the Lagos metropolis. Further, a review of similar studies carried out in other real estate markets was conducted in order to identify a comprehensive list of attributes that influence property values from the literature and to compare with the situation in the Lagos metropolis.

Table 1. Lagos metropolis studies

Property attributes	Olayiwola et al. (2005)	Bello and Bello (2007)	Ajide and Kareem (2010)	Babawale and Johnson (2012)	Babawale et al. (2012)	Oloke et al. (2013)	Famuyiwa and Babawale (2014)
Location		✓					
Accessibility to place of work	✓	✓	✓				
Accessibility to CBD	✓						
Accessibility to public transport facility	✓		✓				
Proximity to highway						✓	
Accessibility to School				✓			
Accessibility to shopping mall				✓			
Neighbourhood characteristics	✓					✓	
Availability of neighbourhood security		✓	✓	✓	✓	✓	✓
Availability of electricity		✓					✓
Availability of pipe borne water supply			✓		✓		
Availability of waste disposal system			✓				✓
State of repair of the property		✓					
Size of property				✓			
Age of the property		✓					
Numbers of bedrooms				✓	✓	✓	
Number of bathrooms/toilets			✓	✓	✓		
Building characteristics				✓			
Availability of security fence					✓		
Size of bedroom					✓	✓	

From Table 2 it can be seen that the most significant factor that influences property value in other real estate markets is property size. It occurred seven out of the nine studies which depicts that home seekers in these markets place more emphasis on the size of a property, when making real estate property decision. A comparison of the Lagos property market studies with these of other real estate markets reveal that property attributes influencing value are location- specific, which necessitates the need for market segmented studies.

Table 2. International studies

Property attributes	Mbachu and Lenono (2005)	Choy et al. (2007)	Ge and Du (2007)	Selim (2008)	Zietz et al. (2008)	Pozo (2009)	Anim-Odame et al. (2009)	Sanjari (2012)	Baltagi et al. (2015)
Location	✓		✓			✓	✓		
Accessibility to place of work									
Accessibility to CBD								✓	
Accessibility to public transport facility	✓	✓							
Proximity to highway									
Accessibility to School									
Accessibility to shopping mall									
Neighborhood characteristics									
Availability of neighborhood security	✓								
Availability of electricity									
Availability of pipe borne water supply				✓					
Availability of waste disposal system	✓								
State of repair of the property									
Size of property		✓	✓	✓	✓	✓	✓	✓	
Age of the property									
Numbers of bedrooms	✓		✓	✓			✓		
Number of bathrooms/toilets					✓	✓			✓
Building characteristics	✓			✓	✓				✓
Availability of security fence	✓								

3 Research Methodology

In literature, quantitative modelling technique has been used to assess the effect of property attributes on property value (Murie, 1998). However, survey research approach was adopted in this study. The need to collect data on the perception of real estate professionals (a large study population) on the attributes that influence property value in the Lagos metropolis (a large study area) makes survey research approach well suited for this study. This is corroborated by the assertions that can be found in Easterbrook et al. (2008). It is argued that the preference of this research approach in built environment disciplines can be linked to the need for generalization, hypothesis testing and comparative analysis (Laryea and Leiringer, 2012; Phua, 2013).

The Lagos metropolis was chosen as the study area for this research. Lagos has been adjudged as a megacity by the United Nations due to large population and the volume of commercial activities that takes place in the city of Lagos (Lagos State Government, 2015). In addition, a

large majority of multinational companies operating in Nigeria have their head-offices located within Lagos (Babawale and Oyalowo, 2011) and the city is the most vibrant real estate market in Nigeria (Oni, 2010). Ibiyemi and Tella (2013) points out that over 50% of registered real estate professionals and firms are practicing and domiciled in Lagos; therefore, it is reasonable to suggest that Lagos metropolis is a justified choice.

In consonance with suggestions put forward in Murie (1998), it was recommended that for housing studies, retrieving information from real estate professionals is important. Hence, the respondents of this study are professional members of the Nigerian Institution of Estate Surveyors and Valuers (NIESV). NIESV is empowered by Decree No. 24 of 1975 of The Laws of the Federal Republic of Nigeria, to regulate real estate professionals in Nigeria. Being a professional member of NIESV means that such a person has acquired the minimum academic qualification, experience and professional expertise to practice as a real estate professional. Out of the 1794 registered members in the 2014 NIESV membership directory, a stratified random sample of 150 valuers practicing in Lagos metropolis who had email addresses in the directory were selected for the study. This is in line with suggested sample sizes in similar previous studies (See for instance Kauko (2007); Adewunmi and Olaleye (2011); Ameyaw and Chan (2015)).

The list of attributes generated and presented in Table 1 was used to design an online questionnaire which was administered on the respondents. The first section of the questionnaire focuses on the demographic details of the respondents while the second section consist the attributes which the respondents were asked to rank in the order of importance on a five-point Likert scale. The scale adopted is from 1 - 5 representing highly insignificant - highly significant, respectively.

The electronic questionnaire was sent to the valuers and they were expected to respond within two months. An additional one month extension was granted at the expiration of the initial two months and this was done to increase the response rate. At the end of the survey period, an effective response rate of 35% was recorded. This is above the common margin of 20-30% obtainable in the similar studies (Akintoye and Fitzgerald, 2000).

The mean scores (MS) was adopted in ranking the attributes in order to establish their level of significance, due to its appropriateness for studies of this nature (Adair et al., 1996). The MS was estimated using the formula in Equation (1). However, in an attempt to categorise the Relative Importance of the attributes, the following criteria was adopted:

Highly significant = MS of 4.00 and above, Significant = MS of between 3.50 and 3.99 Slightly significant = MS of between 3.00 and 3.49 and Insignificant = MS of less than 3.00

$$MS = \frac{5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}{N} \quad (1)$$

Where n is the score given by valuers based on a five-point scale of 1 to 5 and N is the number of valuers that rated an attribute.

In order to confirm the reliability of the data collected, the Cronbach's alpha test was conducted to establish the internal consistency of the responses. Oyedele (2013) posit that the Cronbach alpha if item/attribute deleted means that the deletion of such item will result to an improved reliability of the data. This was conducted to measure the effective contribution of each attribute to the overall data.

4 Analysis and Results

Results from the data analysis revealed that 67% of the professionals have acquired at least Bachelor of Science degree, 33% have obtained Higher National Diploma, while none possess neither High School Certificate nor a Doctor of Philosophy degree. At the same time, 44% of

the valuers have working experience ranging between 6-10years, 33% have 0-5 years of industry experience, 17% have experience of between 11 and 15 years, in addition, 6% have 15 years and above years of experience. The characteristics of the respondents suggest that they are well informed and conversant with the real estate industry.

The Cronbach's alpha value of 0.843 was recorded for all the attributes which shows a high level of internal consistency that is above the minimum acceptable value of 0.70 as posited by Hair et al. (2010). The Cronbach's alpha if item is deleted for the attributes ranges between 0.822 (size of bedroom and accessibility to place of work) and 0.841 (state of repair of property), all these values are less than that of the overall Cronbach's alpha value (0.843). This connotes a significant contribution of all the attributes to the internal reliability of the data and they were therefore, all retained for the analysis.

Table 3. Ranking of property value determinants

Factors	Mean Score	Overall ranking	Criticality
Location	4.92	1	H. significant
Neighborhood characteristics	4.31	2	H. significant
State of repair of the property	4.23	3	H. significant
Availability of neighborhood security	4.06	4	H. significant
Size of property	4.06	4	H. significant
Age of the property	4.00	5	H. significant
Numbers of bedrooms	3.98	6	Significant
Number of bathrooms/toilets	3.90	7	Significant
Availability of electricity	3.81	8	Significant
Accessibility to place of work	3.79	9	Significant
Accessibility to CBD	3.75	10	Significant
Building characteristics	3.75	10	Significant
Availability of security fence	3.73	11	Significant
Availability of pipe borne water supply	3.65	12	Significant
Accessibility to public transport facility	3.62	13	Significant
Size of bedrooms	3.60	14	Significant
Proximity to highway	3.56	15	Significant
Availability of waste disposal system	3.38	16	S. significant
Accessibility to School	3.15	17	S. significant
Accessibility to shopping mall	3.13	18	S. significant

Note: H. significant is highly significant and S. significant is slightly significant.

Information in Table 3 shows that the MS of the attributes ranges between 4.92 and 3.13, that is for property location and accessibility to shopping mall, respectively. Based on the evaluation indices set earlier, out of the 20 attributes, six are highly significant to real estate property investment in the Lagos metropolis, 11 are significant, three are slightly significant, while none of the attribute is insignificant.

5 Discussion

Location as a property attribute has been widely examined in real estate research. Property location has been proven to significantly influence property value in different real estate markets around the world as reported by McCluskey et al. (2000), Kauko (2003), Ge and Du (2007), amongst others. This variable was ranked as most highly significant in the Lagos metropolis, which conforms to existing literature, suggesting that homebuyers will consider the location a property when making residential decisions.

The second highly significant variable in this study is neighbourhood characteristics. Which suggest that homebuyers in the metropolis consider the characteristics of a neighbourhood when making real estate decisions. This was established in the studies of Han et al. (2002), Kauko (2003) that homebuyers are willing to pay a premium for a property situated in a neighbourhood characterised with pleasant features. This conforms to the study of Iroham et al. (2014) that found that neighbourhoods that are characterised with modern buildings designs, good roads, ocean view, building constructed with modern building materials commands higher property value.

Gallimore et al. (1996), Clark and Herrin (2000), Amenyah and Fletcher (2013) reported that homebuyers prefer to buy or rent a property located in a safe neighbourhood. Indicating that security of lives and properties is paramount to real estate consumers. This is the same case in the Lagos metropolis as reported in Table 3, where neighbourhood security is ranked as highly significant determinant of property value.

The state of repair of a property which defines the finishes and aesthetics of a property is also ranked amongst the highly significant attributes in this study. As documented by Mbachu and Lenono (2005) that the state of repairs of a property in terms of finishes, beauty, design, etc. is a significant real estate property value determinant. This means that a real estate property in a good state of repairs, will command a higher value when compared to these in a bad state of repair.

Homebuyers belong to different socio-economic and cultural class. Their income, needs and taste may influence the amount they may be willing to pay for a property. On the other side, the bigger the size a of property, the higher the construction cost, which will be reflected in the property value (Ge and Du, 2007). This is also the position of Owusu-Ansah (2012) that argued that the bigger the size of a property, the higher the value of such property. The review conducted by **Sirmans et al. (2005)** also revealed that property size significantly influenced property value in 42 out of the 52 occurrences of the attributes in studies. This is the case in the Lagos metropolis as discovered in this study. The attribute has a MS of 4.06 which makes it highly significant to real estate property value formation.

As documented by Chin and Chau (2002), the age of a property has a significant influence on its value, but this relationship is negative. Meaning that as the age of a property increases, so will the value of the subject property be decreasing. The explanation for this is that as a property gets older, the components begin to wear and tear and there may be need for some level of refurbishment, renovation or repairs and all these comes at a cost which may not be associated with similar new property. Therefore, a rational homebuyer will be willing to pay the added premium on the value of a newer building than an old one. This is evident in the Lagos metropolis property market as the attribute was ranked highly significant to property value, as this is also the case in other real estate markets (Choy et al., 2007); Tse, 2002).

6 Conclusion and Further Research

Due to the complexity of the real estate markets and especially that of a megacity, this research was embarked on to establish the critical determinants of real estate property value, which in turn affects real estate investments in the Lagos metropolis, Nigeria. A review of the literature

was conducted in order to develop a comprehensive list of real estate property value determinants in the Lagos metropolis and in other real estate markets around the world. A questionnaire was designed by utilizing these twenty retrieved attributes. The questionnaire was administered on experienced real estate professionals practicing in the study area for them to rank these attributes according to their level of importance and significance. It was found that six out of the twenty attributes significantly influence real estate property value in the Lagos metropolis real estate market and in their order of importance they include property location, neighbourhood characteristics, state of repair of the property, availability of neighbourhood security, size of property, and age of property. Although none of the attribute was ranked as insignificant, the remaining variables were either found to be significant or slightly significant. The goal of every real estate investors and built environment professionals acting as property investment advisors is to maximize profit, therefore, these highly significant attributes should be considered as important criteria when making investment decisions in the real estate sector in Lagos, Nigeria. The findings of this study will ensure that real estate property is developed in such a way that it will meet the taste and preference of the targeted real estate consumers, which will consequently result in profit optimization.

This survey focused on the Lagos metropolis property market, however, a country-wide survey will provide a broad overview of the determinants of real estate property value in other cities in Nigeria. This will be useful to existing and prospective real estate investor as it will show what homebuyers in different real estate markets prefer and are willing to pay for.

It is of essence to indicate at this point that this research is a pilot study to a bigger research targeted at modeling the Lagos metropolis real estate market. The list of property value attributes generated in this study are peculiar to the study area and will be employed as the explanatory variables for the development of artificial intelligence models for the Lagos metropolis property market. Artificial intelligence modeling techniques that have proven to be reliable and accurate for property value modeling, have received much attention in other real estate markets but have not in the Nigerian real estate research domain, will be experimented in the metropolis.

7 Acknowledgement

The authors sincerely acknowledge the Research Grants Council of Hong Kong (SAR) and the Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong for providing financial and material support towards this research.

8 References

- Adair, A., Berry, J. and McGreal, S. (1996). Valuation of residential property: Analysis of participant behaviour. *Journal of Property Valuation and Investment*, 14(1), 20-35.
- Adewunmi, Y. A. and Olaleye, A. (2011). Real estate research directions and priorities for Nigerian institutions. *Journal of Real Estate Practice and Education*, 14(2), 125-140.
- Ajide, B. K. and Kareem, I. (2010). Hedonic analysis of residential housing market in a third world city: A preliminary investigation. *The Social Sciences*, 5(6), 520-524.
- Akintoye, A. and Fitzgerald, E. (2000). A survey of current cost estimating practices in the UK. *Construction Management & Economics*, 18(2), 161-172.
- Aluko, B. T. (2007). Examining valuer's judgement in residential property valuations in metropolitan Lagos, Nigeria. *Property Management*, 25(1), 98-107.
- Aluko, O. (2011). The effects of location and neighbourhood attributes on housing values in metropolitan Lagos. *Ethiopian Journal of Environmental Studies and Management*, 4(2), 69-82.
- Amenyah, I. D. and Fletcher, E. A. (2013). Factors determining residential rental prices. *Asian Economic and Financial Review*, 3(1), 39-50.

- Ameyaw, E. E. and Chan, A. P. C. (2015). Risk ranking and analysis in PPP water supply infrastructure projects. *Facilities*, 33(7/8), 428-453.
- Anim-Odame, W., Key, T. and Stevenson, S. (2009). Measures of real estate values from land registration and valuation systems in emerging economies: The case of Ghana. *Journal of Real Estate Literature*, 17(1), 63-84.
- Azmi, A. S. M., Nawawi, A. H., Ab Latif, S. N. F. and Ling, N. L. F. J. (2013). Property valuers' receptive level on knowledge of computer aided valuation (CAV) system. *Procedia-Social and Behavioral Sciences*, 105, 734-744.
- Babawale, G., Koleoso, H. and Otegbulu, C. (2012). A hedonic model for apartment rentals in Ikeja area of Lagos metropolis. *Mediterranean Journal of Social Sciences*, 3(3), 109-120.
- Babawale, G. K. and Johnson, O. (2012). The specification of hedonic indexes for duplexes in Lekki peninsular area of Lagos metropolis. *Elixir Social Science*, 45, 7689-7698.
- Babawale, G. K. and Oyalowo, B. A. (2011). Incorporating sustainability into real estate valuation: The perception of Nigerian valuers. *Journal of Sustainable Development*, 4(4), 236-248.
- Baltagi, B. H., Bresson, G. and Etienne, J. M. (2015). Hedonic housing prices in Paris: An unbalanced spatial lag pseudo-panel model with nested random effects. *Journal of Applied Econometrics*, 30(3), 509-528.
- Bello, M. O. and Bello, V. A. (2007). The influence of consumers behavior on the variables determining residential property values in Lagos, Nigeria. *American Journal of Applied Sciences*, 4(10), 774-778.
- Chin, T. L. and Chau, K. W. (2002). A critical review of literature on the hedonic price model. *International Journal for Housing Science and its Applications*, 27(2), 145-165.
- Choy, L. H., Mak, S. W. and Ho, W. K. (2007). Modeling Hong Kong real estate prices. *Journal of Housing and the Built Environment*, 22(4), 359-368.
- Clark, D. E. and Herrin, W. E. (2000). The impact of public school attributes on home sale prices in California. *Growth and Change*, 31(3), 385-407.
- Easterbrook, S., Singer, J., Storey, M.-A. and Damian, D. (2008). Selecting empirical methods for software engineering research. In F. Shull, J. Singer and D. I. K. Sjøberg (Eds.), *Guide to advanced empirical software engineering* (pp. 285-311). London: Springer.
- Famuyiwa, F. and Babawale, G. K. (2014). Hedonic values of physical infrastructure in house rentals. *Journal of Facilities Management*, 12(3), 211-230.
- Gallimore, P., Fletcher, M. and Carter, M. (1996). Modelling the influence of location on value. *Journal of Property Valuation and Investment*, 14(1), 6-19.
- Ge, X. J. and Du, Y. (2007). *Main variables influencing residential property values using the entropy method—the case of Auckland*. Paper presented at the 5th International Structural Engineering and Construction Conference, Shunan, Japan.
- Hair, J., Black, W., Babin, B., Anderson, R. and Tatham, R. (2010). *Multivariate data analysis* (7th ed.). New Jersey: Prentice-Hall.
- Han, S., Yu, M. S., Malone-Lee, C. L. and Basuki, A. (2002). Dynamics of property value distribution in an Asian metropolis: The case of landed housing in Singapore, 1991-2000. *Journal of Property Investment & Finance*, 20(3), 254-276.
- Ibiyemi, A. and Tella, E. (2013). Critical issues in economic risks consideration by commercial property investors and valuers in Nigeria: The case of Lagos. *International Journal of Emerging Science and Engineering*, 1(12), 35-43.
- Iroham, C., Durodola, O., Ayedun, C. and Ogunbola, M. (2014). Comparative study of rental values of two gated estates in Lekki peninsula Lagos. *Journal of Sustainable Development Studies*, 5(2), 218-235.

- Kauko, T. (2007). An analysis of housing location attributes in the inner city of Budapest, Hungary, using expert judgements. *International Journal of Strategic Property Management*, 11(4), 209-225.
- Kauko, T. J. (2003). Residential property value and locational externalities: On the complementarity and substitutability of approaches. *Journal of Property Investment & Finance*, 21(3), 250-270.
- Lagos State Government. (2015). Population. Retrieved 3rd March, 2015 from <http://www.lagosstate.gov.ng/pagelinks.php?p=6>.
- Laryea, S. and Leiringer, R. T. F. (2012). *Built environment research in West Africa: Current trends and future directions*. Paper presented at the West Africa Built Environment Research (WABER) Conference, Abuja, Nigeria. 24 - 26 July.
- Li, C. W., Wong, S. K. and Chau, K. W. (2011). An analysis of spatial autocorrelation in Hong Kong's housing market. *Pacific Rim Property Research Journal*, 17(3), 443-462.
- Mbachu, J. I. and Lenono, N. (2005). *Factors influencing market values of residential properties*. Paper presented at the Queensland University of Technology Research Week International Conference, Brisbane, Australia. 4-8 July.
- Mbachu, J. I. C. (2003). *A critical study of clients' needs and satisfaction in the South African building industry*. (Doctoral dissertation), The University of Port Elizabeth, South Africa.
- McCluskey, W. J., Deddis, W. G., Lamont, I. G. and Borst, R. A. (2000). The application of surface generated interpolation models for the prediction of residential property values. *Journal of Property Investment & Finance*, 18(2), 162-176.
- Murie, A. (1998). Uncertainty and fragmentation: Social aspects of housing studies. In A. J. H. Smets and T. Traerup (Eds.), *Housing in Europe: Analysing patchworks* (pp. 21-32). Utrecht: Danish Building Research Institute, Utrecht University.
- Olayiwola, L. M., Adeleye, O. A. and Oduwaye, A. O. (2005). Correlates of land value determinants in Lagos metropolis, Nigeria. *Journal of Human Ecology*, 17(3), 183-189.
- Oloke, C. O., Simon, F. R. and Adesulu, A. F. (2013). An examination of the factors affecting residential property values in Magodo neighborhood, Lagos state. *International Journal of Economy, Management and Social Sciences*, 2(8), 639-643.
- Oni, A. O. (2010). *Harnessing real estate investment through decision process for selecting tenants in Nigeria*. Paper presented at the 10th African Real Estate Society Conference, Naivasha, Kenya. 26th-29th, October.
- Owusu-Ansah, A. (2012). Examination of the determinants of housing values in urban Ghana and implications for policy makers. *Journal of African Real Estate Research*, 2(1), 58-85.
- Oyedele, L. O. (2013). Avoiding performance failure payment deductions in PFI/PPP projects: Model of critical success factors. *Journal of Performance of Constructed Facilities*, 27(3), 283-294.
- Phua, F. T. (2013). Construction management research at the individual level of analysis: Current status, gaps and future directions. *Construction Management and Economics*, 31(2), 167-179.
- Pozo, A. G. (2009). A nested housing market structure: Additional evidence. *Housing Studies*, 24(3), 373-395.
- Rosen, S. (1974). Hedonic prices and implicit markets: Product differentiation in pure competition. *The Journal of Political Economy*, 82(1), 34-55.
- Rosenhead, J. (1989). Introduction: Old and new paradigms of analysis. In J. Rosenhead (Ed.), *Rational analysis for a problematic world: Problem structuring methods for complexity, uncertainty and conflict* (pp. 1-20). Singapore: John Wiley and Sons.
- Sanjari, H. (2012). Estimation of the hedonic pricing function for housing units (A case study

- of Hashtgerd New Town, Iran). *International Business Management*, 6(6), 676-679.
- Selim, S. (2008). Determinants of house prices in Turkey: A hedonic regression model. *Doğuş Üniversitesi Dergisi*, 9(1), 65-76.
- Sirmans, S. G., Macpherson, D. A. and Zietz, E. N. (2005). The composition of hedonic pricing models. *Journal of Real Estate Literature*, 13(1), 1-44.
- Tse, R. Y. (2002). Estimating neighbourhood effects in house prices: Towards a new hedonic model approach. *Urban Studies*, 39(7), 1165-1180.
- Tse, R. Y. and Love, P. E. (2000). Measuring residential property values in Hong Kong. *Property Management*, 18(5), 366-374.
- Zietz, J., Zietz, E. N. and Sirmans, G. S. (2008). Determinants of house prices: A quantile Regression approach. *The Journal of Real Estate Finance and Economics*, 37(4), 317-333.

WORKERS’ PERCEPTIONS REGARDING HEALTH AND SAFETY (H&S) PRACTICES IN THE NIGERIAN CONSTRUCTION INDUSTRY

Kukoyi, Patricia; Smallwood, John

Department of Construction Management, Faculty of Engineering, the Built Environment and Information Technology, Nelson Mandela Metropolitan University, Port Elizabeth, South Africa

Abstract

Construction projects are reputed for their poor H&S record when compared to other industries. This can be attributed to an uncontrolled working environment, risk, workers’ behaviour in relation to H&S commitment, cultural and religious beliefs, and uncertainties inherent in projects. These expose workers, engaged in productive activities on construction projects, to hazards, and risks, which result in fatalities and other injuries. The aim of this study is to explore the perceptions of workers regarding H&S and how they relate to their behaviour on construction sites. The study employed a largely qualitative research approach. Various construction workers (ironworkers, masons, carpenters, roofers, and electricians) were interviewed on sites in Lagos State, Nigeria. The findings of the study reveal that workers view productive activities on construction sites as hazardous and risky. However, H&S practices are viewed by workers as unimportant. This perception may also be attributed to their socio-economic realities, cultural and religious beliefs, and inadequate training. Therefore, it is vital for the government and stakeholders in the construction industry in Nigeria to establish localised H&S certifications, policies, and awareness through traditional and religious organisations so as to foster commitment to H&S on construction sites. Further research is needed to understand the training needs of workers in the Nigerian construction industry.

Keywords: Health and Safety, Nigeria, Perceptions, Workers

1 Introduction

The construction industry is generally viewed as an accident-prone industry. Studies on H&S in the field of construction management reiterate the poor H&S performance on construction sites as a global phenomenon (Zhou *et al.*, 2013).

Previous studies have shown that poor H&S practices among workers significantly contribute to the poor H&S performance reported in construction-related studies (Haslam *et al.*, 2005; Choudhry and Fang, 2008). Also, complexities experienced in the industry due to changing technology, construction methods, clients’ demands, construction materials and the changing environment have made hazards and risk controls difficult (Odeyinka *et al.*, 2006). Thus, there is an obvious need to improve H&S practices on construction sites.

The need to have a shift in H&S culture within the construction industry is imperative to ensure work is carried out in a healthy and safe manner. According to the International Labour Organisation (ILO, 2005), an estimated 2.3 million people die every year from work-related accidents and diseases and there are 313 million non-fatal accidents per year. Furthermore,

30% of workers suffer from musculoskeletal disorders and more than 20%-40% of work-related deaths occur on construction sites in industrialised countries. In the United Kingdom (UK), 31% of all occupational related deaths dated in 2002/2003 were from the construction industry (Haslam *et al.*, 2005). Chi and Han (2013) also state that on every work day, more than three workers do not return home due to fatalities experienced on construction sites in the United States of America (USA). Similarly, South Africa had fatalities and accident rates of 19.2 and 14 626 per 100,000 workers respectively. This is said to be lower than that of sub-Saharan countries estimated at 21 and 16 021 per 100 000 workers respectively (cidb, 2008). Cokeham and Tutesigensi (2013) note the high accident rate in Rwanda, and the increase in other sub-Saharan countries. Based on the aforementioned, it can be seen that poor H&S performance within the construction industry is a global problem.

H&S problems lead to poor performance of construction projects (Hinz, 1997). Studies have demonstrated that accidents are associated with increased operation costs due to poor productivity, cost of medical care for victims, loss of person hours, absenteeism, and an adverse impact on the image of the organisation (Hinze, 1997; Willkins, 2011). These losses suggest the need to establish effective ways to reduce accidents on construction sites. Willkins (2011) further relates the high rate of injuries and deaths to workers' non-compliance with H&S procedures, inadequate training, and inadequate knowledge of H&S practices. Thus, this necessitates the need for a study to understand how workers view H&S practices in the construction environment.

As highlighted in the opening paragraph, arguments and evidence indicates that the construction industry has a poor H&S record. Despite the fact that Nigeria is a member of the ILO, H&S provisions and conventions are not properly implemented (Umeokafor *et al.*, 2014). This is aligned to the assertion by Idoro (2008) that there are no policies prescribed for H&S in the Nigerian construction industry, therefore contractors and workers are left to use their discretion. This may be accountable for the poor productivity (Khosravi *et al.*, 2014) when workers execute work in an unhealthy and unsafe environment. Furthermore, it is known that research provides a body of knowledge that guides a discipline. A review of past-published and unpublished studies in construction management-related disciplines in Nigeria and the West-African region reveal that H&S related research has been limited (Laryea and Leiringer, 2012; Ejohwomu and Oshodi, 2014). However, it should be noted that a study focused on the difference in health, safety and environment practices of construction companies; the relationship between compliance to regulations and the incidence of fatalities on construction sites in the Nigerian construction sector as reported in Windapo and Jegede (2013). Therefore, the objective of this study is to explore H&S perceptions on construction sites.

2 H&S Practices in the Nigerian Construction Industry

The Nigerian construction industry is not immune to the H&S problems of the construction industry. There are no adequate records of construction accidents (Idoro, 2004) or statistics of fatal accidents, disabilities due to construction accidents and deaths (Mohamed *et al.*, 2009). Although there is no statistical data, the number of buildings that collapsed (Olusola, 2013) during construction in several parts of the country over the years points to the existence of poor H&S practices.

In addition, the construction industry lacks adequate H&S regulations and if available, they do not apply to the construction industry (Idoro, 2008). This is similar to other developing countries such as Pakistan (Mohamed *et al.*, 2009). This has prompted stakeholders such as contractors, supervisors, workers, and professionals to use their discretion to address H&S issues on construction sites. Furthermore, non-enforcement of statutory regulations and legislation, poor governance, and inadequate infrastructure has limited the progress of H&S in

developing countries (Idoro, 2004; Idoro, 2008; Mohamed *et al.*, 2009). In addition, the existing framework is not tailored to meet the immediate need of the industry. There is also a lack of support from the government, a lack of concern from professional institutions, corruption in the system, and low levels of education of employees (Idubur and Oisamoje 2013; Umeokafor *et al.*, 2014). These challenges have an unfavourable effect on implementing H&S best practices in the construction industry. The effects are poor project performance, poor quality of executed works and unethical practices (Cokeham and Tutesigensi, 2013). Therefore, understanding workers' perceptions on H&S practices and integrating best practices for H&S in the Nigerian construction industry could significantly improve the construction industry.

2.1 Improving H&S Performance in the Construction Industry

Implementing H&S best practice on construction sites can be challenging. This may be due to the migration of workers, method of worker employment, work standards, different backgrounds and experience (Mohamed *et al.*, 2009). H&S is of little concern in developing countries because H&S issues are considered after the accident has occurred and the industry is driven by the profits to be made (Priyadarshani *et al.*, 2013; Windapo, 2013). Agumba, Pretorius and Haupt (2013) define H&S management as "tangible practices, responsibilities and performance related to H&S, including the association between H&S management, climate and culture." They categorise H&S practices into five basic elements, namely top management commitment and involvement in H&S, employee involvement and empowerment in H&S, project supervision, project H&S planning and communication in H&S and H&S resources, and training. Their study reveals that employee involvement and empowerment in H&S are regarded as irrelevant. It was recommended that workers should be engaged at the project level to improve H&S performance on construction sites. However, H&S management techniques should be tailored to meet the unique needs of the worker.

Researchers such as Cheng *et al.* (2004), Cheng *et al.* (2012), and Ismail *et al.* (2012) opine that limiting human errors will reduce accidents, which can only be achieved by employing H&S management best practices on site. When the system is driven positively to reduce hazards and risks, workers will adopt good behaviours to foster positive commitment to H&S. Smallwood (1995) maintains that management commitment to H&S is reflected in the organisation's values, policy, goals, programme development, resource allocation, behaviour modeling, and injury analysis. Thus, understanding how workers perceive H&S may lead to valuable insights that can be determined to improve on-site construction H&S.

Windapo and Jegede (2013) are of the opinion that fatalities, injuries, and deaths are mainly caused by unsafe and unhealthy practices of contractors and workers. Contractors prefer to spend less on PPE, employ less experienced workers for cheap labour and care only for the profits to be made. Similarly from a qualitative survey, Khosravi *et al.* (2014) identified 8 main categories of factors that influence workers' unsafe and unhealthy behaviours on construction sites. These factors include society, organisation, project management, supervision, contractor, site conditions, work group, and individual characteristics. Workers' perceptions of risk, H&S management, H&S regulations and procedures have been linked to their attitude towards H&S on construction sites (Mohamed *et al.*, 2009). The aforementioned study reveals that workers have a self-rated competence and their behaviour relates to their own H&S responsibilities.

3 Research Methodology

This study is part of an on-going study on construction workers' H&S practices on construction sites. The objective of the qualitative study is to explore workers' perceptions on H&S practices in the construction industry. Qualitative methods process variables as an exploration of ideas and concepts. It is inductive by giving detailed descriptions and interactions between the inquirer and the respondent at their natural state. This method was adopted because it is

adequate for a small sample size (Levy & Henry, 2001; Creswell, 2012). To obtain the data for the study, a semi-structured interview was employed. The interview questions were designed based on the literature review conducted prior to the actual data collection. The data provides actual words of the respondents, hence adequate to achieve deeper insights into the problems being explored. The findings of Baradan and Usmen (2006) determine that roofers, iron workers, electricians, painters, and masons were more at H&S risk and ranked highest in fatalities when compared to other work trades in the construction industry. Based on this finding, a worker from each of the trades was selected and interviewed. The small size of respondents (interviewees) was to allow an in-depth discussion and for the workers to fully express their ideas without restrictions.

The questions were structured to allow the respondents to discuss their general impression of H&S on site, work environment, and how work is conducted in a healthy and safe manner. All ethical issues were addressed such as formally requesting to visit and interview the respondents, explaining the purpose for the research, and requesting for the workers' consent based on a voluntary decision to be interviewed. The interviewees selected are outsourced employees of contracting firms. The contracting firms selected for this study are registered with the Nigerian Institute of Building (NIOB). There are 191 construction firms registered with the NIOB. Ninety-two (92) of these firms are based in Lagos. The selected firms were those undertaking projects at the time of the research. Further questions were asked to prompt discussions in relevant areas during the interview. The interviews were recorded with permission, and were conducted in local languages before translating into English, then transcribed. The interview sessions were conducted during the lunch breaks and after-work hours. This was because two of the workers interviewed, preferred to be interviewed after work. Their ages, educational status, and years of experience were noted.

3.1 Interviewees' Characteristics

Table 1. Characteristics of the interviewees

Interviewee code	Trade	Gender	Age	Highest Qualification	Years of experience
R1	Roofer	Male	Adult	Primary education	10
R2	Ironworker	Male	Adult	Secondary education	16
R3	Electrician	Male	Adult	Trade school certificate	13
R4	Painter	Male	Adult	Secondary education	9
R5	Mason	Male	Adult	Primary education	9

The interviewees (Table 1) were all male adults between the ages of 30-49 and they all had more than 8 years' work experience, which indicates adequate work experience to provide responses that reflect actual practices on construction sites. The interviewees have been engaged in several projects ranging from engineering works (dam, road, and bridge construction) and building structures (residential and commercial buildings). This reveals that the interviewees' had varied work experiences on different construction sites. This will enhance the quality of the responses on H&S. Of the five respondents, only one had a trade school certificate. The other four were primary and secondary school leavers; they all learned their trade through informal training, i.e. working as an apprentice until they were set to work on their own.

4 Findings and Discussion

4.1 Workers' Trade Union

Interviewee R2 and R5 are members of their Trade Unions. The benefits as members are basically for welfare purposes. They can easily access loans and receive help in the case of any dispute. However, their responses were similar stating that contractors do not entertain unionism on construction sites. This was made clear by the following statements: *"I am a union member because when I need help they will help me. We make monthly contributions as members and we get information about work easily."* *"I was a union member when I was on permanent employment with a big company as a union member; we fight for our wage increase or when they don't treat us well."* *"When I get employed for work on any site, I do not tell them I am a union member because you may not get the job; they say as union members we fight always."*

4.2 Management Commitment to H&S / Employee Involvement in H&S

Although the interviewees did not attest to any onsite H&S policies, regulation or rules, interviewees perceived that some managers were committed to their wellbeing while others were not. According to R3, *"Most of the sites I have worked have different types of managers and with different behaviour. Some will make your work easy because they want good work done" and "others will make you work and work making you accomplish some impossible workload as a day's job because they want to save money."* Management commitment to H&S was perceived by the interviewees as not sufficient. They are of the opinion that H&S is not important on most sites according to R2: *"Where I worked, they don't say anything about H&S."* However, R3 is of the opinion that *"We were taught how to keep our environment clean after work so that your work will be neat and also the site."* Getting involved with H&S on site depends on the Management. However, due to workers' level of education, most workers prefer not to get involved with Management R1: *"we are not as educated as they are so we just work."* The workers prefer to do their work and get paid their wage. Furthermore, management does not have respect for the workers as indicated by an interviewee. He (R1) is of the opinion that management is more concerned about work rather than their H&S; R5: *"But some managers do not see us workers as human beings. I am saying this because the man (i.e. the contractor's representative) was more concerned about the work being done right rather than about us."* R3: *"Managers, engineers and supervisors talk to us with disrespect. This often occurs especially when the work is delayed."*

All the interviewees gave accounts revealing that the management of contracting firms was not committed to implementing H&S during the construction stage. Responses from interviewees above included managers who expected workers to carry out tasks that cannot be accomplished within the time frame allotted to the task. Their concern as stated above implies management's poor H&S commitment on construction sites. However, workers do not see H&S as a priority.

4.3 H&S Training

Interviewees indicated that H&S training is generally not conducted on construction sites as suggested by R5: *"There is nothing like H&S meetings or training since I started working with this contractor"* and R4: *"I do not know anything about H&S training."* They have not attended any H&S training. Therefore, the workers regarded H&S training as unnecessary to their work. They are of the opinion that, H&S officers are not available on site, H&S meetings were not conducted, and communication was through the supervisors and foremen. R1: *"The management does not involve us in any meeting so that we can talk better; they mostly talk with our foremen. The foremen will now pass the information down to us."*

As regards to PPE, the interviewees indicated that they were familiar with some PPE such as goggles, ear plugs, hand gloves, helmet (hard hat), boots, reflective jackets, and overalls. However, the use of PPE was not regarded as important or necessary. Interviewees expressed their opinions - R3: "Some of the PPE were not durable; they were of low quality and these contractors buy them to reduce cost", and R2: "They give me hard helmet and boots, only a pair." This indicates that management does not commit adequate resources to H&S and do not care about the H&S of their workers. In addition, workers do not understand the need to wear H&S equipment due to various reasons as indicated by some of the interviewees; R4: "PPE in this hot weather! The weather is too hot to wear them; it makes me very uncomfortable, I will be sweating." R5: "It is only when the client and other professionals are coming to site for inspection that my manager will bring them out and insist we wear helmets, boots and overalls." R1: "The helmet and overall are not necessary. I like using the hand gloves. I do not think I really need it for my job." However, others indicated that some managers they have worked with insisted they use PPE as reported by R3: "I have worked on sites where the managers will insist we use our PPE."

4.4 Workers' Perceptions of Risks

The workers were further asked if they were aware of the degree of risk and hazards related to their work and how accidents are reported on site. Some of the workers affirmed that working on construction sites involves risk. However, they have worked long enough on the job to avoid accidents; they know the "tricks on the job." Interviewee R1 views risk in this way: "Every job has a risk, if no risk then no money. It is not easy to climb on a roof and work; the higher it is, the more the money. I have been doing this job and I am still alive; I think when you are afraid that is when you fall." They believed they are safe. Others believed they are at risk only when their supervisors or managers insist on a method which they are not familiar with and they try not to get afraid. R5: "My boss tells me to do some work and I do the work the best way I can. I feel safe. I am a man I cannot be afraid of my work. I like my work". R2 and R4 have a similar view: "For me, when something wants to happen it does happen and you cannot stop it. It is just God or our forefathers that is keeping us safe because we have to provide for our families." "We just have to do the job"; "I just pray to God to help me do my work well and not to get injured." Accidents, according to one of the respondents "Happen every day, you just have to be careful. Some days you may be unlucky and other days you are not, and if you get injured often you may not be employed again" and that "Reporting accidents depends on the seriousness of the accident. Managers handle serious cases, and accidents are investigated with help from the foremen or supervisors. When an accident leads to death the families are compensated, but I do not know if the police get involved."

The qualitative results provide evidence of the lack of management commitment to H&S and the lack of respect towards workers in the Nigerian construction industry. These have affected the effective management of H&S within the Nigerian construction industry. Hence, the poor H&S practices on construction sites. In addition, workers are not involved in H&S in the organisation, which may be a major contributing factor to inadequate policy formation and implementation especially with respect to H&S in the construction industry in developing countries.

The findings of this study reveal that the activities of workers' unions are limited on construction sites. The unions are not adequately represented on construction sites in Nigeria. Furthermore, if trade unions are fully established, they could be a platform to promote H&S on construction sites and engender management commitment and workers' involvement in H&S. This is buttressed by the findings of various studies regarding how unions and union workers have contributed to improving H&S on construction sites in various countries (see Debobeeleer, 1990: Ulubeyli *et al.*, 2014). In addition, workers are aware of the risks and

hazards associated with work. This is different from the findings of Ulubeyli *et al.* (2014) which suggest that workers are not aware of the risks or hazards on construction sites. However, this study suggests that the workers were more interested in monetary gains, than concern for the risks they were exposed to, and relate accidents to lack of precautionary methods when at work. This may be attributable to the low socio-economic characteristics of the workers, and the existence of 'cheap labour'. Furthermore, risks and hazards, associated with the workers' trades on construction sites, are also viewed within the context of workers' religious beliefs. This result is in agreement with Smallwood's (2002) findings, which demonstrate the link between H&S and religion.

Lastly, the results of the study also raised related questions regarding the available H&S training for workers on construction sites. Workers lack formal H&S training, and do not see the need for any training. This is therefore, an indication that H&S is not a priority to workers and to management. The need for adequate codes of conduct, policy formulation, and implementation in the construction industry in Nigeria is vital.

5 Conclusions and Further Research

The construction work environment is complex and the need to adopt best H&S practices to constantly keep the environment healthy and safe for workers should be adopted. This paper explored the perceptions of workers on H&S on construction sites. The findings of the study reveal that workers view construction activities as hazardous to them, and are more interested in the monetary gains. They have little or no knowledge of what H&S in construction is about due to a lack of H&S training. Consequently, H&S is not considered important. Workers view that the number of years spent in a trade determines the level of risk they are being exposed to, and how to manage it. Also, religion is a determining factor of how risk is perceived and managed. Therefore, the workers expose themselves to avoidable risks. In summary, their perceptions could be linked to management inadequacies in promoting best H&S practices, socio-economic realities, cultural beliefs, and inadequate training. The need to train workers in the Nigerian construction industry should be seen as important and the government needs to establish policies and collaborations with agencies that will foster commitment to H&S on construction sites. Given that the findings are not representative of the total number of workers, it should be seen as a limitation to the study, and therefore cannot be generalised. However, the findings provide insight to stakeholders in the industry as regards H&S. Further research is needed to understand the training needs of workers in the Nigerian construction industry. Construction Managers could plan H&S strategies with foremen to systematically analyse work risks and hazards. This will enable management to improve the H&S climate on projects, and to develop an H&S culture among workers through adequate policy formulation and implementation.

6 References

- Agumba, J., Pretorius, J., & Haupt, T. (2013). Health and safety management practices of small and medium enterprises in South Africa construction industry. *Acta Structilia*, 20(1), 66-80.
- Baradan, S., & Usmen, M. (2006). Comparative injury and fatality risk analysis of Building trades. *Journal of Construction, Engineering and Management*, 132(5), 533-539.
- Cheng, E.W., Ryan, N., & Kelly, S. (2012). Exploring the perceived influence on safety management practices on project performance in the construction industry. *Safety Science*, 50, 363-369.
- Cheng, E., Li, H., Fang, D., & Xie, F. (2004). Construction safety management: an exploratory study from China. *Construction Innovation*, 4, 229-241.

- Chi, S., & Han, S. (2013). Analysis of systems theory for construction accident prevention with specific reference to OSHA accident reports. *International Journal of Project Management*, 31, 1027-1041.
- Choudhry, R., & Fang, D. (2008). Why operatives engage in unsafe work behaviour: Investigating factors on construction sites. *Safety Science*, 46, 566-584.
- CIDB. (2008). *Construction health and safety in South Africa status and recommendations*. Pretoria.
- Cokeham, M., & Tutesigensi, A. (2013). An investigation of construction accidents in Rwanda: perspective from Kigali. *Management, Procurement and Law*, 166(4), 179-187.
- Creswell, J.W. (2012). *Educational Research: planning, conducting and evaluating quantitative and qualitative research*. Boston, United States of America: Pearson Education.
- Debobbeleer, N. (1990). Safety performance among union and nonunion workers in the construction industry. *Journal of Occupational Medicine*, 32(11), 1099-1103.
- Ejohwomu, O., & Oshodi, O. (2014). A review of construction management and economics research outputs in Nigeria: Towards a sustainable future. *Journal of Construction Project Management and Innovation*, 4, 900-905.
- Haslam, R., Hide, S., Gibb, A., Giyi, D., Pavitt, T., Atkinson, S., & Duff, A. (2005). Contributing factors in construction accidents. *Applied Ergonomics*, 36, 401-415.
- Hinze, J.W. (1997). *Construction Safety*. New Jersey: Prentice- Hall.
- Idoro, G.I. (2004). The effect of globalization on safety in the construction industry. *International symposium on globalization. Construction School of Civil Engineering Asian Institute of Tecnology*. Bangkok, Thailand.
- Idoro, G.I. (2008). Health and safety management efforts as it correlates with performance in the Nigerian construction industry. *Journal of Civil Engineering and Management*, 14(4), 277-285.
- Idubor, E., & Oisamoje, M.D. (2013). An exploration of health and safety management issues in Nigeria's effort to industrialize. *European Scientific Journal*, 9(12), 154-170.
- International Labour Office. (2013). *The health of workers in selected sectors of the urban economy: Challenges and perspective*. Geneva: Sectorial Activity Department.
- Ismail, Z., Doosder, S., & Harun, Z. (2012). Factors influencing the implementation of a safety management system for construction sites. *Safety Science*, 50, 418-423.
- Khosravi, Y., Asilian-Mahabadi, H., Hajizadeh, E., Hassanzadeh-Rangi, N., Bastani, H., & Behzadan, A. (2014). Factors influencing unsafe behaviors and accidents on construction sites: A review. *International Journal of Occupational Safety and Ergonomics*, 20(1), 111-125.
- Larsyea, S., & Leiringer, R.T. (2012). Built environment research in West Africa: current trends and future directions. In: *Proceedings 4th West African Built Environment Research (WABER) Conference*, Abuja, Nigeria, 24-26 July 2012, 797-804).
- Levy, D., & Henry, M. (2001). An analysis of published property research methodologies and methods. *The cutting edge*, 3-11.
- Mohamed, S., Ali, T., & Tam, W. (2009). National culture and safe work behaviour of construction workers in Pakistan. *Safety Science*, 47, 29-35.
- Odeyinka, H.A., Oladapo, A., & Akindele, O. (2006). Assessing risk impacts on construction cost. In: *Proceedings of the Annual Construction and Building Research Conference of the Royal Institution of Chartered Surveyors*, London, United Kingdom, 7-8 September 2006, 1-13.
- Olusola, K.O. (2013). Builders document: preparation of health and safety management plan in relation to building projects. *Annual seminar publication*, 1-14. Ado-Ekiti, Ekiti, Nigeria.

- Priyadarshani, K., Karunasena, G., & Jayasuriya, S. (2013). Construction safety assessment framework for developing countries: case study of Sri Lanka. *Journal of Construction in Developing Countries*, 18(1), 33-51.
- Smallwood, J.J (2002). Health and Safety (H&S) and religion: Is there a link? In: *Proceedings Triennial Conference CIB W099 Implementation of Safety and Health on Construction Sites*. Hong Kong: Department of Real Estate University of Hong Kong, 7-10 May 2002, 201-206.
- Smallwood, J.J. (1995). *The influence of management on the occurrence of loss causative incidents in the South African construction industry*. MSc Dissertation. Construction Management, University of Port Elizabeth South Africa.
- Toole, T. (2002). Construction site safety roles. *Journal of Construction Engineering and Management*, 128(3), 203-210.
- Torner, M., & Pousette, A. (2009). Safety in construction- a comprehensive description of the characteristics of high safety standards in construction work, from the high combined perspective of supervisors and experienced workers. *Safety Research*, 40, 399-409.
- Ulubeyli, S., Kazaz, A., & Er, B. (2014). Health and safety perception of workers in Turkey: A survey of construction sites. *International Journal of Occupational Safety and Ergonomics*, 20(3), 323-338.
- Umeokafor, N., Umeadi, B., & Jones, K. (2014). Compliance with occupational safety and health regulation:A review of Nigeria's construction industry. In: *3RD International Conference on Infrastructural Development in Africa*. Abeokuta, 17-19 March 2014.
- Wilkins, J.R. (2011). Construction workers perception of health and safety training program. *Construction Management and Economics*, 29, 1017-1026.
- Windapo, A.O., & Jegede, O.P. (2013). A study of Health, Safety and Environment (HSE) practices of Nigerian construction companies. *The professional Builder*, 4(1), 92-103.
- Zhou, Z., Irizarry, J., & Li, Q. (2013). Applying advanced technology to improve safety management in the construction industry: a literature review. *Construction Management and Economics*, 32(6), 606-622.

IMPACT OF PROJECT MANAGER’S LEADERSHIP COMPETENCES ON COMPLEX MEGA INFRASTRUCTURE PROJECT PERFORMANCE: A LITERATURE REVIEW.

Nyariranwge, Maxwell; Babatunde Oluwayomi

School of Construction Economics, University of the Witwatersrand, Johannesburg, Gauteng, South Africa

Abstract

This study aims to establish the impact of project managers’ competences in addressing project complexity and enhancing complex infrastructure projects delivery success. The objectives include determining the dimensions and levels of project complexity; delineating the competences required to manage project complexity; establishing an integrative project performance evaluation criterion; and developing a model that validates the impact on infrastructure projects performance by linking the different complexity dimensions with required competences. This study constitutes the conceptual phase of an on-going broader research. Consequently, the methodology used is an integrative review of the existing literature on the key concepts including project management, leadership and complexity. The study’s results showed that infrastructure projects are complex adaptive systems, which cannot be adequately managed by controlling tripple constraint factors. Project managers must be flexible, innovative and able to learn and adapt new behavioral patterns, in order to adequately manage the complexity levels and dimensions involved. Additionally, the need for project managers’ capabilities to balance between administrative processes, adaptive and generative leadership styles was emphasised. Consequently, a Complexity-Leadership Alignment Model was developed to validate the link between the project manager’s leadership competences and ability to deal with different dimensions and levels of project complexity. In conclusion, this study underscores the role played by the project managers’ competences in enhancing infrastructure projects delivery success. The limitation is that the findings only illuminate key constructs, which will be empirically tested under the subsequent phases of the study.

Keywords: Mega infrastructure projects, Project complexity, Project leadership, Project management, Project performance

1 Introduction

The role of mega infrastructure projects in the economic development particularly among developing countries, characterised by a myriad of socio-economic challenges, cannot be overemphasised (Srinivasu and Srinivasa Rao, 2013). The underperformance of these infrastructure projects, hence, represents a significant but avoidable loss of economic value (Liu, 2009). In South Africa, the economic profile shows a 5% contribution from construction sector (Statistics South Africa, 2015). South Africa embarked on an infrastructure-focused development policy since the year 2000. This resulted in the rolling-out of mega projects like the Gautrain Rapid Rail system, the Gauteng Freeway Improvement program and the Bus Rapid Transit projects across thirteen cities (Presidential Infrastructure Coordinating

Commission, 2012; Economic Development Department, 2011). The government has also set a target to generate a minimum of two million jobs prioritising skilled, semi and unskilled youth categories from previously disadvantaged groups, by the year 2020 (Development Department, 2011). Intense public sector investment in infrastructure projects was one of the core drivers to create employment and stimulate economic growth through various multiplier effects (Presidential Infrastructure Coordinating Commission, 2012; Economic Development Department, 2011).

The successful delivery of mega infrastructure projects is very critical, as they are largely financed from public funds and, hence, compete for priority with other critical social services. The performance of mega infrastructure projects attracts socio-political interest, which affects the reputation of the organisations involved. Mega infrastructure projects are complex systems, which can neither be easily understood through simple linear approaches, nor effectively managed through controlling efficiency measures of time, cost and quality (Hazy and Uhl-Bien, 2013). The general underperformance of mega infrastructure projects (Murugesan, 2012, Riaz et al., 2014) has, therefore, brought the current delivery processes, approaches and management philosophy under scrutiny (Riaz et al., 2014; Shenhar, 2012).

This study underpins the attribution of project failure to qualitative factors such as the project manager's leadership competences, internal and external complexity and gaps in the project management philosophy (Shenhar, 2012; Thamhain, 2012; Back, 2012; Jacques et al., 2007). Consequently, the aim of this study is to establish the impact of project managers' competences in addressing project complexity and enhancing infrastructure projects delivery success. The objectives include determining the dimensions and levels of project complexity; delineating the competences required to manage project complexity; establishing an integrative project performance evaluation criterion; and developing a model that validates the impact on infrastructure projects performance by linking the different complexity dimensions with required competences. The subsequent sections below is a review of existing literature, focusing mainly on the key study constructs, which include project management philosophy, mega infrastructure project complexity and required project leadership competences. This is subsequently followed by a summary of the main findings and associated conclusions.

2 Literature Review

This section of the paper establishes the different constructs regarding project performance, based on an integrative review of existing literature. The investigation draws from the analysis of the main factors behind project performance, which, as outlined in the preceding sections of this paper, include the gaps in the current project management philosophy, project complexity and project managers' leadership competences.

2.1 Project Management Philosophy

Although project performance has been studied for a long time, there has been no universally accepted definition, measurement criteria or what constitutes project success (Han et al., 2013). Different studies have come up with an inexhaustible list of measurement metrics, which have resulted in inconsistencies in the conclusion. In an attempt to deal with the ambiguity, minimize variability of factors and generate objective measures, a distinction has been made between project success and project management success (Han et al., 2013; Turner and Zolin, 2012).

Turner and Zolin (2012) proffered the need to incorporate the priorities of different project stakeholders when measuring project performance. These different stakeholders' views and priorities vary in time after project completion. Shenhar (2012) underpinned this view by demonstrating that stakeholder judgement of project success has very little to do with the triple constraint factors. This was supported by cases where, despite exceeding planned time and budgets, some projects were still considered to be very successful, while those completed on

time and within budgets failed to satisfy the needs of investors. These findings underpinned some of the gaps associated with the performance evaluation criteria used under the traditional project management philosophy.

The narrow focus on project goals associated with traditional project performance evaluation criteria was refuted by Aubry and Hobbs (2010), because of the ambiguities involved. They recommended a broader criteria, which incorporates project delivery impacts on organizational value was recommended. The organisational impact was conceptualized under the economic and pragmatic dimensions (Almahmoud et al., 2012). While the former focuses more on demonstrating the direct economic contribution of projects to the organization's bottom line, the latter focuses on addressing the multifaceted nature of project performance beyond just financial indicators (Aubry and Hobbs, 2010). A balance between the two dimensions was recommended in order to harness both the financial and non-financial contributions that project management brings to organizational success. These successes elements include innovation, new organizational processes and employee and team development, as depicted under the balanced scorecard (Shenhar, 2012).

Almahmoud et al., 2012 distilled that a distinction must be made between success factors and success criteria. The former cover a priori conditions that contribute to positive results, while the latter are used to assess a concrete and measurable result a posteriori (Almahmoud et al., 2012). This view was also upheld by Turner & Zolin (2012) who advanced the need for triangulating performance evaluation criteria to adequately address the multi-faceted nature of projects. Project performance factors were grouped into five categories which include efficiency, impact on the team, impact on the customer, business success, and preparing for the future (Turner & Zolin, 2012). Time dimensions include the short term outputs (immediately after project completion), medium term outcomes (few months after project completion), and long term impacts (evaluated years after project completion) were explored (Shenhar, 2012). This study upholds the comprehensiveness associated with the proposed criteria in addressing the gaps highlighted by Aubry and Hobbs (2010) in the foregoing section. Consequently, this criteria is one of the core elements that will be used to develop a conceptual framework for the subsequent phases of this study.

2.2 Mega Infrastructure Project Complexity

Mega infrastructure projects are, generally, large scale in nature, require huge budgets, and are delivered through complex multiple partnerships between the private and public sectors (van Marrewijk et al, 2008). The delivery of these projects involves integrated project management organizations, which consist of multiple institutions, different skills and multi-disciplinary teams and complex contracts (van Marrewijk et al., 2008). These characteristics make mega infrastructure projects susceptible to uncertainty, political sensitivity and multi-stakeholder interest (van Marrewijk et al., 2008). Consequent to the factors above, these projects are perceived as complex adaptive systems, which need to be well understood and delivered using appropriate competences, to be successfully (Curlee and Gordon, 2011). Based on these key characteristics, this study uses the terms 'mega' and 'complex' interchangeably to refer to large scale infrastructure projects. In South African, projects qualify under this category include the Gauteng Freeway Improvement Program, Gautrain Rapid Rail Link, Medupi Power Station, Bus Rapid Transit (BRT) projects, and so on.

The performance of many mega infrastructure projects has been unsatisfactory (van Marrewijk et al., 2008). Mega infrastructure projects often overrun budgets, fall behind delivery schedules and fail to deliver and fully address the need behind their commissioning (van Marrewijk et al., 2008). For instance the cost of the Gautrain Rapid Rail Link ballooned from R3.5 billion - R30.462 billion between 2000 and 2011 (Fombad, 2013). Causes behind this failure involve different project complexity factors such as magnitudes of team competences, inaccurate

budget estimates, delays in critical decisions and approvals, changes in project specifications, diverging stakeholder interests, technological factors, and so on (Fombad, 2013).

2.2.1 Complexity Theory

The field of complexity has been studied over a couple of decades, broadly under Complexity Theory (Curlee and Gordon, 2011). Complexity Theory has a universal application across many disciplines such as mathematics, science, meteorology and social sciences, was born out of Chaos theory (Curlee and Gordon, 2011). There are three dimensions of complexity, which are algorithmic, deterministic and aggregate complexity (Mason, 2001). This study focuses more on aggregate complexity, which is concerned with how the interaction between individual elements in a system propagates complex behaviour. The key attributes of aggregate complexity include relationships between a system's internal structure and the surrounding environment, the resultant learning and emergent behaviour, and the different means by which complex systems change and grow (Hazy and Uhl-Bien, 2013).

A system is defined more by the nature of relationships than its constituent parts (Curlee and Gordon, 2011). Therefore, the capacity of a system is greater than the sum total of its constituent subsystems and elements. This implies that a system can have emergent qualities that cannot be easily traceable by analysing its constituent elements (Curlee and Gordon, 2011). Relationships define, and are influenced by a system's internal structure. Well-connected components form subsystems either sustain or destabilize the system's structure (Curlee and Gordon, 2011; Saywisch, 2010).

It was further distilled that complex systems also owe their existence to how they interact with their external environment (Curlee and Gordon, 2011). They achieve this by actively anticipating change and reacting to it, as well as shaping their environments through learning, referring to history and utilizing existing relationships and subsystems (Curlee and Gordon, 2011). Therefore, systems are not static but constantly evolve through self-organization to better interact with their environments. They also dissipate when they struggle to cope with pressures from the internal and external environmental forces (Hazy and Uhl-Bien, 2013).

Complexity Theory refutes the fundamental project management premise which prescribes rational approaches to simplify phenomena as well as finding "best" linear procedures in solving project challenges (Hazy and Uhl-Bien, 2013). The foundational basis of Complexity Theory is, hence, the notion that order, which is the kingpin of management principles of control, does not allow for sufficient flexibility to deal with all human interactions (Curlee and Gordon, 2011). This study underpins this view by positioning that the success and failure of a project is not only a result of how the triple constraints are managed but rather the outcome of complex interactions among individual elements and the resultant complex behaviour and relationship structures (Curlee and Gordon, 2011).

2.2.2 Complexity and Project Management

Projects by nature operate as complex open systems (Curlee and Gordon, 2011). Consequently, a system can be construed as: "an object which in a given environment aims at reaching some objectives (teleological aspect) by doing an activity (functional aspect) while its internal structure (ontological aspect) evolves through time (genetic aspect) without losing its own identity" (Vidal and Marle, 2008 pp. 1095). It then follows that projects as complex systems are defined by these key systematic characteristics (Vidal and Marle, 2008). This underscores the need for project managers to possess leadership competences that enable them to better understand complex systems so as to effectively and successfully deliver on infrastructure projects (Azim et al, 2010).

Project complexity levels lie on a continuum from control, complicated, complex to chaotic (Remington, 2011). The least complex projects are those where the project manager is in control most of the project processes and inter-relationships, while the most complex are those where there is complete chaos (Remington, 2011). This study opines that projects, as complex systems, are rarely in stable states for project managers to exercise full control, particularly given the dynamic nature of the inter-relationships involved. Consequently, this study posits creativity and innovation among project teams, as being the cornerstones for successful performance as opposed to excessive administrative and control processes. Complexity has further been articulated as “complexity in projects” and “complexity of projects” (Geraldi et al., 2011) and consequently categorised into five types including structural complexity, uncertainty, pace, socio political environment, and dynamics (Remington, 2011).

2.3 Leadership Styles and Project Performance

The failure of infrastructure projects across the globe has brought the efficacy of traditional project management tools, practice and competences under scrutiny (Ren et al, 2012). Human factors were highlighted as the main determinants of projects performance (Jiang, 2014; Zhang and Fan, 2013). Research accentuated that most engineering practitioners are trained to be reactive (and largely in relation to management of the triple constraint) and, consequently, are under-equipped to deal with complexities associated with infrastructure construction projects (Riaz et al., 2013). Different leadership competences have been established, resulting in a variety of theories and models (Dinh et al., 2014; Murugesan, 2012). However, this nomenclature has not been conclusive enough to establish a solid theory. The absence of such a theory, which adequately empirically links leadership with project success, represents a gap in the existing literature which still needs to be investigated (Crawford; 2014; Shao et al., 2012). Based on the research gaps and shortcomings identified, this study’s objectives are important as discussed subsequently. Firstly, leadership competences are required beyond traditional project management (Chaudhry et al., 2012). This enables project managers to embrace the different project complexity factors, anticipate challenges and opportunities and align these with the expectations of the different project stakeholders (Chaudhry et al., 2012). Secondly, mega infrastructure project environment are characterised by different complex factors and dynamics, which demand astute leadership skills beyond traditional project management competences (Riaz et al., 2013). Thirdly, the increasingly competitive project environment requires project managers with unique skills to inspire teams towards business success, growth and competitiveness (Crawford, 2014). Lastly, mega infrastructure projects operate as unique temporary organisations, with special characteristics (short lifespan, multi-disciplinary human resource composition, strict delivery scope, timelines and budgets), whose management demands a unique set of leadership competences beyond traditional project management (Eweje et al., 2012). On the basis of these important insights, this study underscores the need to deal with the gaps in the project management philosophy in order to equip project managers to deal with complexity and improve on performance.

3 Research Methodology

This paper is the first phase of an ongoing research, whose methodology consists of an integrative review of existing relevant literature. This is critical to explore the main constructs that address the research aim and objectives. The theoretical framework guiding this literature review consisted of complexity theory, project management and leadership theories, as well as project performance measurement models and frameworks. The main approach involved critiquing, synthesizing and reconceptualising of the literature findings since the elements under study are not new (Torraco, 2005). The integrative literature review process involved about five key stages. Firstly, relevant journals that deal with the project management,

leadership and complexity fields were selected using the Social Science Citation Index as well as the Web of Science (Torraco, 2005). Secondly, journal articles published between the year 2000 and 2015, focusing on project management, leadership and complexity, were selected. Thirdly, the most recent articles (2008-2015) were prioritised, although selected older ones were also reviewed to establish the trends in the key findings, arguments and conclusions regarding project management, leadership and complexity. The main criteria for selection included the articles' focus on the core constructs, the methodology used and the main findings and conclusions reached. This is summarised in Table 1.

Table 1. Summary of literature review methodology flow

THEORETICAL FRAMEWORK	RELEVANT LITERATURE SELECTION	CORE CONSTRUCTS	INTEGRATIVE LITERATURE REVIEW	KEY OUTPUTS (THIS STAGE)	KEY OUTPUTS (FSUBSEQUENT STAGES)
<ul style="list-style-type: none"> • Complexity Theory • Project Management Theory • Project Leadership Theory • Project Performance Measurement Models 	<ul style="list-style-type: none"> • Journal Articles published between 2008 and 2015. • Limited number of journal articles older than 2008 • Limited number of other non-journal articles and books 	<ul style="list-style-type: none"> • Project Management • Project Leadership • Project Complexity 	<ul style="list-style-type: none"> • Critical Analysis • Synthesizing • Reconceptualization 	<ul style="list-style-type: none"> • Trends across constructs • Relationships between constructs • Main knowledge gaps • Key conclusions • Key questions • Integrative model 	<ul style="list-style-type: none"> • Conceptual Framework • Research questions • Research propositions • Research Methodology

(Source: Author)

The review processes focused on critical analysis of the articles, to distil key trends regarding project management, leadership and complexity, as well as relationships between these constructs. This was important in establishing critical gaps and in drawing specific conclusions relevant to the study purpose. The study topic, problem statements, aim and objectives were the lens through which the various articles were selected and reviewed. The last stage involved the synthesis of the main findings to establish a model which integrates project management, leadership and complexity. The model will be used to develop the conceptual framework which will guide the subsequent stages of the research.

4 Findings and Discussion

4.1 Project Management Philosophy

Through the review of literature, this study has established the need for project performance evaluation to address the overall project objectives and integrate them with broad organisational goals over different time dimensions (Shenhar, 2012). Consequently, project success was accentuated as a better evaluation criterion which addresses both internal and external efficiency and effectiveness than project management success. The latter only focuses on internal measures of efficiency regarding time, cost and quality (Han et al., 2013). A further triangulation of evaluation criteria was proffered in order to capture the financial and non-financial contribution of project performance to organisational value (Shenhar, 2012). Other elements incorporated in the criteria include the views of different stakeholders and the time dimensions involved (Turner and Zolin, 2012).

This triangulation improves the comprehensiveness of the evaluation criteria beyond that of the linear and unitary measures used under the traditional project management philosophy

(Hazy and Uhl-Bien, 2013). This is important, particularly given insights drawn from Complexity Theory outlined in the foregoing sections (Han et al., 2013). These findings underscore the limitations associated with the current project management philosophy and underpin the need for project manager leadership competences.

4.2 *Mega Infrastructure Project Complexity*

By reviewing existing literature, this study has established that the current project management approaches and practices often fail to effectively address the different complexity dynamics highlighted in the preceding sections (Turner and Zolin, 2012). This has been highlighted as a gap in the traditional project management philosophy. This gap can be underpinned by the exclusion of the subject of complexity from the Project Management Body of Knowledge (PMBOK), which has remained despite the persistent challenges faced by project managers in dealing with complexities within and beyond project boundaries (Han et al., 2013). On this basis of this gap, this study highlighted project complexity as one of the important constructs, which will be explored in greater detail in the subsequent phases. Of particular focus is the complexity dimensions and levels, as well as the required leadership competences alignment to adequately internalise and manage the former and improve on project performance.

4.3 *Leadership Competences and Project Performance*

Based on the output of the integrative literature review, this study has established the need for leadership competences beyond traditional project management capabilities (Clarke, 2012). This has been underpinned by the findings that at least 80 percent of project failure is associated with human factors (Shenhar, 2012). It was also distilled that project environments acts as complex adaptive systems (CAS), under which the project manager can either promote or stifle performance (Hazy and Uhl-Bien, 2013). CAS require capabilities in creative problem solving, learning and adapting. Consequently, in order to address the unique challenges involved in a CAS, project managers need to be flexible, innovative and open to learning and adapting new behavioural patterns (Ren et al, 2012).

Leadership under CAS requires the astute balancing between administrative, enabling and adaptive styles (Han et al., 2013). Administrative leadership involves bureaucratic processes of alignment, top-down control and reliance on leaders' vision and inspiration. Focus is also on planning and coordination to accomplish prescribed outcomes in an efficient and effective manner (as typically required under the traditional project management philosophy) (Han et al., 2013). Enabling leadership, on the other hand, establishes the necessary conditions that promote team creativity, innovation and learning, in solving problems. Lastly, adaptive leadership results from emergent change activities, in response to generative dynamics within a system. (Ren et al, 2012).

Another concept which has been established under the integrative literature review is emergence. This is a unique behaviour associated with complex adaptive systems as they respond to environmental pressure. It involves three elements of self-organisation and re-formation (Ren et al, 2012). This study has established that since mega infrastructure operate as complex adaptive systems (Hazy and Uhl-Bien, 2013), they are susceptible to emergence. Emergence suggest that, when bureaucratic processes and procedures are simplified, constraints associated with administrative leadership can channel and generate attributes that promote performance in a system (Ren et al, 2012). Consequently, in order to improve performance, project managers will be required to understand the complex adaptive system's emergence properties and design well-balanced, effective and responsive systems (Han et al., 2013). When project managers lack this understanding, they emphasise administrative and bureaucratic controls and, consequently, stifle the team's innovation, creativity and

entrepreneurship capabilities, which are important for performance (Ren et al, 2012). This is summarised in Figure 1.

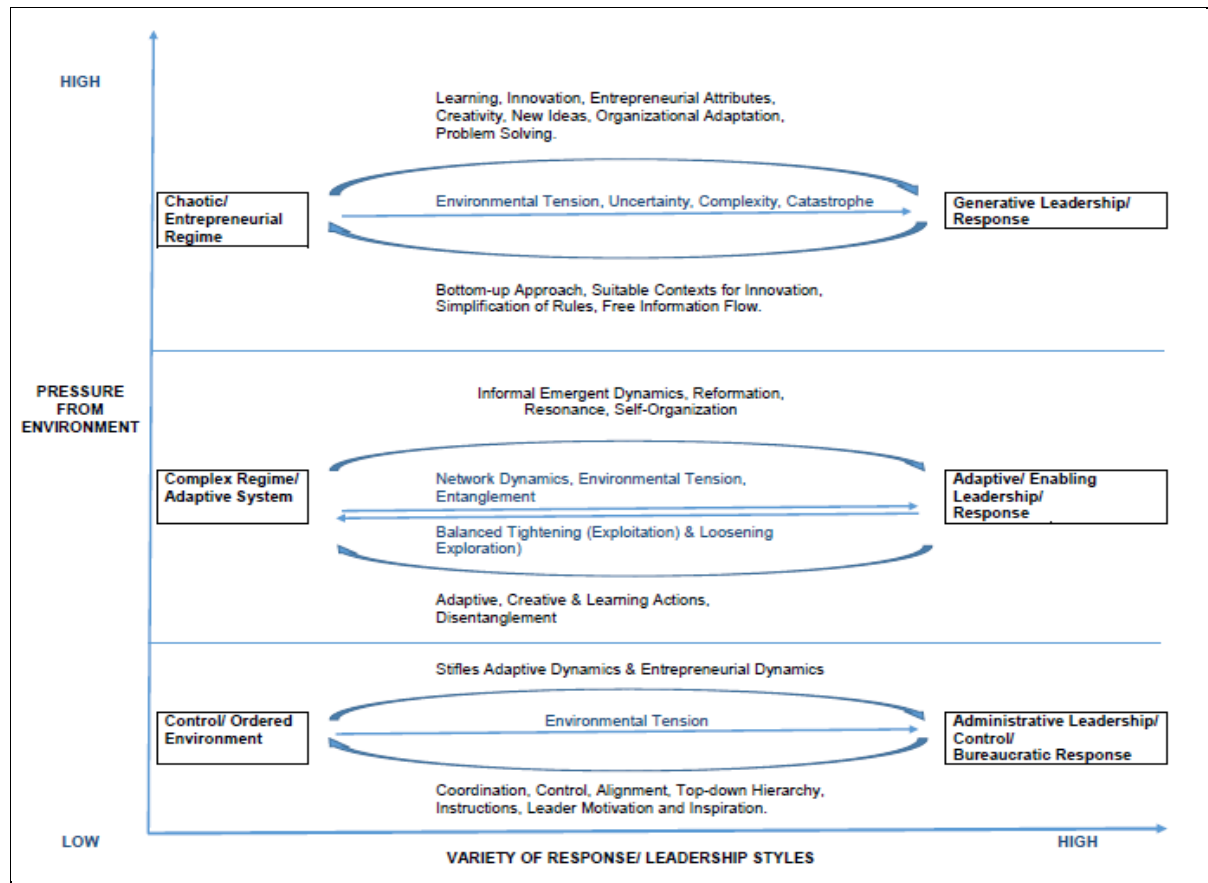


Figure 1. Categories of leadership styles for complex adaptive systems (Source: Adopted from Uhl-Bien et al., 2007; Hazy et al., 2007)

Other important complex adaptive system properties, which have been established through the integrative literature review are intertwinement or entanglement. These two properties manifest whenever the system’s agents interact (Hazy and Uhl-Bien, 2013). They require project managers to carefully balance between the three leadership styles distilled in the preceding section. This balancing process involves emphasizing administrative and bureaucratic processes (which focus on drive efficiency) under stable conditions, and alternately activating and emphasizing adaptive leadership attributes during periods of turbulence, intense competition, uncertainty and complexity. Generative leadership attributes will be emphasized when entrepreneurial and innovative attributes are required (Ren et al, 2012). This is important in order to prevent administrative processes from suppressing adaptive attributes through too strict and rigid bureaucratic controls, which may consequently, stifle innovation, creativity and entrepreneurship (Ren et al, 2012). These processes have been accentuated as some of the gaps in the traditional project management practices. The competences required to enable project managers to achieve this go beyond the traditional project management philosophy.

The insights drawn from the foregoing sections of this study were crystallised into an integrative Complexity-Leadership Alignment Model. The model combines the leadership categorization and the complexity dynamics. Consequently, an attempt has been made to validate the impact of the project manager’s leadership competences and ability to deal with different levels of complexity impacts on performance. The model is provided in Figure 2.

LEADERSHIP STYLES	COMPLEXITY LEVELS			
Generative/ Creativity, Innovation and Change Leadership Styles	Levels of Leadership Adaptability High ↑ Low ↓			Chaos (tipping point), risk events escalate rapidly, Innovation and learning is high, Crisis leadership, directive, rapid action required to prevent total collapse.
Adaptive/ Complexity/ Enabling/ Emergent Leadership Styles		Expert-based, consultative leadership.		Experimental, collaborative leadership
Administrative/ Traditional/ Established Leadership Styles		Stable environment (processes are clear and things go according to plan). Simple best practice traditional leadership, top down influence, motivating processes, alignment to procedures and organizational vision.		
	Low	Control/ Ordered	Complicated	Complex
				Chaos High
LEADERSHIP STYLES	COMPLEXITY LEVELS			

Figure 2. Complexity-Leadership Alignment Model (Source: Author)

5 Conclusion and Further Research

This study achieved the aim by distilling that the competences required under CAS are beyond traditional project management founding principles of controlling time, cost and quality. This raises a further question as to whether mega project success or failure can be ascribed to the project manager's training or individual agility. The study also achieved the first objective by highlighting the three dimensions of project complexity, where aggregate complexity was selected for more focus under the subsequent phase of this research. The question is whether all projects exhibit similar complexity dimensions and levels, and whether this happens across the entire delivery cycle. The second objective was also achieved through the delineation of administrative, adaptive and enabling leadership styles and the need for balance to deal with the emergence properties associated with complex adaptive systems. The question is whether the project management training sufficiently equips project managers to fulfil these requirements. The third objective was achieved by recommending project success as a more preferred comprehensive and integrative criterion than project management success. The questions remain regarding the role of different stakeholders in designing the project evaluation criteria, performance measurement metrics and key performance indicators. In order to address the fourth objective, this study developed an integrative Complexity-Leadership Alignment Model, which links project leadership and complexity in an attempt to validate the associated impact on project performance. This link will still need to be measured through analysis of empirical data. Overall, this study illuminated the inadequacy of the conventional project management philosophy, the dearth in project managers' leadership competences and project complexity as some of the critical factors behind the unsatisfactory performance of mega infrastructure construction projects. The questions which arose out of this stage of the study form the basis for further exploration under the subsequent stages.

6 References

- Almahmoud, S. E, Doloi, H. K and Panuwatwanich, K (2012). Linking project health to project performance indicators: Multiple case studies of construction projects in Saudi Arabia. *International Journal of Project Management*. Vol. 30 (2012) pp.296-307.
- Aubry, M and Hobbs, B (2010). A Fresh Look at the Contribution of Project Management to Organizational Performance. *Project Management Journal*, Vol. 42 (1) pp.3–16.
- Back, W. E (2012). An Organizational Approach to Leadership Development for Engineering and Construction Management Project Practitioners. *International Journal of Business, Humanities and Technology*. Vol. 2 (2) pp.121-131.
- Barry, M.L and Uys, L (2011). An investigation into the status of project management in South Africa. *South African Journal of Industrial Engineering*. Vol. 22 (1): pp.29-44.
- Cavaleri, S and Reed, F (2008). "Leading dynamically complex projects". *International Journal of Managing Projects in Business*. Vol. 1 (1) pp.71 – 87.
- Chaudhry, M. S, Kalyar, M.N and Rehman, A (2012). The Impact of Leadership on Project Performance. *Industrial Engineering Letters*. Vol. 2 (2) pp.18-24.
- Clarke, N (2012). "Leadership in projects: what we know from the literature and new insights", Team Performance Management: *An International Journal*. Vol. 18 (3/4) pp. 128 – 148.
- Crawford, L (2014). Balancing Strategy and Delivery: the executive view. *Procedia - Social and Behavioral Sciences*. Vol. 119 (2014) pp.857 – 866.
- Curlee, W and Gordon. R.L. (2011). Complexity Theory and Project Management. Willey.
- Economic Development Department, Republic of South Africa (2011). The New Growth Path Framework.
- Eweje, J, Turner, R and Müller, R (2012). Maximizing strategic value from megaprojects: The influence of information-feed on decision-making by the project manager. *International Journal of Project Management*. Vol.30 (2012) pp.639–651.
- Fombad, M. C (2013). Accountability challenges in public–private partnerships from a South African perspective. *African Journal of Business Ethics*. Vol. 7 (1) 2013.
- Geraldi, J, Maylor, H and Williams, T (2011). "Now, let's make it really complex (complicated): A systematic review of the complexities of projects". *International Journal of Operations & Production Management*. Vol. 31 (9) pp. 966 – 990.
- Han, S. W, Yusof, A. M, Ismail, S and Aun, A. C (2013). Reviewing the Notions of Construction Project Success. *International Journal of Business and Management*. Vol. 7 (1) pp.90-101.
- Hazy, J.K. and Uhl-Bien, M, (2013). "Towards operationalizing complexity leadership: How Generative, Administrative and Community-Building Leadership Practices enact Organizational Outcomes". *Management Department Faculty Publications*. Paper 108.
- Hyvärä, I (2014). Project Portfolio Management in a Company Strategy Implementation: A Case Study. *Procedia - Social and Behavioral Sciences*. Vol.119 (2014) 229 – 236.
- Ika, L. A, Diallo, A and Thuillier, D (2011). "The empirical relationship between success factors and dimensions". *International Journal of Managing Projects in Business*. Vol. 4 (4) pp. 711 – 719.
- Jiang, J (2014). The Study of the Relationship between Leadership Style and Project Success *American Journal of Trade and Policy*. Vol 1 (1) pp. 52-55.
- Li Liu, (2009), "How does strategic uncertainty and project sponsorship relate to project performance?". *Management Research News*, Vol. 32 (3) pp. 239 – 253.
- Mason, S.M (2001). Simplifying Complexity: A Review of Complexity Theory. *Geoforum* 32. pp. 405-414.
- Müller, R and Jugdev, K (2012). "Critical success factors in projects". *International Journal of Managing Projects in Business*. Vol. 5 (4) pp. 757 – 775.

- Murugesan, R (2012). Characteristics and Skills of Leadership for Project Performance. *Journal of Business Management & Social Sciences Research*. Volume 1 (3) pp.1-9.
- Prabhakar, G. P (2008). What is Project Success: A Literature Review. *International Journal of Business and Management*. Vol. 3 (9) pp. 3-10.
- Presidential Infrastructure Coordinating Commission, Republic of South Africa (2012). A Summary of the South African National Infrastructure Plan.
- Riaz, A, Tahir, M. M and Noor, A (2014). Leadership is vital for Project Managers to achieve Project Efficacy. *Research Journal of Recent Sciences*. Vol. 2(6) pp.99-102.
- Remington, K. (2011). Leading Complex Projects. *Gower Publishing*. <http://www.gowerpublishing.com/isbn/9781409419051/> (Accessed on 18 June 2015).
- Saywisch, M (2010). Beyond Frontiers of Traditional Project Management: An Approach to Evolutionary, Self-Organisation Principles and the Complexity Theory. Results of a Research Program. *Project Management Journal*. Vol. 4 (2) pp.21-37.
- Shao, J, Muller, R and Turner, J. R (2012). Measuring program success? *Project Management Journal*. Vol. 43 (1) pp.37-49.
- Shenhar, A (2012). What is Strategic Project Leadership? *2012 PMI Global Congress Proceedings*. Vancouver, Canada.
- Srinivasu, B and Srinivasa Rao, P (2013). Infrastructure Development and Economic Growth: Prospects and Perspectives. *Journal of Business Management and Social Science Research*. Vol. 2 (1) pp.81-91.
- <http://www.statssa.gov.za> (Accessed on 24 November 2015).
- Thamhain, H. J (2012). The Changing Role of Team Leadership in Multinational Project Environments. *Revista de Gestão e Projetos - GeP, São Paulo*. Vol. 3(2) pp.4-38.
- Torraco, R.J (2005) Writing Integrative Literature Reviews: Guidelines and Examples. *Human Resource Development Review* Vol. 4 (3) 356-367.
- Turner, R and Zolin, R (2012). Forecasting Success on Large Projects: Developing Reliable Scales to Predict Multiple Perspectives by Multiple Stakeholders over Multiple Time Frames. *Project Management Journal*. Vol. 43, (5) pp.87-99.
- van Marrewijk, A, Clegg, S.R, Pitsis, T.S and Veenswijk, M (2008). Managing Public-Private Megaprojects: Paradoxes, Complexity and Project Design. *International Journal of Project Management*. Vol. 26 (6) pp.591-600.
- Vidal, L.A and Marle, F (2008). Understanding Project Complexity Implications on Project Management. *Kybernetes* Vol. 37 (8) pp.1094-1110.
- Zhai, L, Xin, Y and Cheng, C (2009). Understanding the value of project management from a stakeholder's perspective: Case study of mega-project management. *Project Management Journal*. Vol. 40 (1) pp.99-109.
- Zhang, L and Fan, W (2013). "Improving performance of construction projects". *Engineering, Construction and Architectural Management*. Vol. 20 (2) pp.195-207.

THE USE OF BUILDING INFORMATION MODELLING AND RELATED TECHNOLOGY IN THE CAPE TOWN URBAN CENTRE

Pinfold, Laura; Fapohunda, Julius Ayodeji

Department of Construction Management and Quantity Surveying, Cape Peninsula University of Technology, Cape Town, South Africa

Abstract

The significant improvement of technology in recent times has provided an opportunity for construction firms to invest in innovative technology. In South Africa the construction industry seems reluctant to deviate from their traditional ways of delivering construction projects. It is believed that building information modelling (BIM) and related technology can be a catalyst for change, with information replacing documents and knowledge becoming an asset. Hence, this research investigates to what extent construction personnel feel innovative technology can stimulate building production to ensure that building projects are completed within timeframes and budgets and what issues influence a construction firm's decision to invest in these technologies. Both qualitative and quantitative survey methods are employed in data collection. Content analysis and descriptive statistics techniques are used in analysing the data. This research gives a clear indication that construction personnel feel BIM and related technology can have a positive impact on building production processes and that cost, risk and logistics are factors to consider when implementing new technology. It is concluded that construction firms utilising these technologies will have a competitive advantage over others that ignore it.

Keywords: Building Information Modelling (BIM), Building production processes, Construction management, Innovative technology, Project management

1 Introduction

Urbanisation and globalisation are the foremost trends propelling the growth and development of cities and towns in the world today (Tah, 2012:348). The Cape Town central business district is an example of an urban centre that is required to deal with rapid urbanisation. The increasing numbers of inner-city developments suggest congested construction sites are rapidly becoming the norm within the industry (Bidy, 2009 cited in Spillane *et al.*, 2011). Therefore innovative building production management is crucial in driving productivity which includes reducing cost at all stages, from planning to completion. According to Hardie (2010) construction firms are not significantly proactive towards using innovative technology that could enhance the efficient delivery of building production. Venkatachalam (2014) adds that improved building production management is advancing at a slow pace both in South Africa and internationally. This becomes problematic as the success of building construction in urban centres hinges upon the ability of the construction firm to be strategic, which is to know what resources are available, and what capabilities to develop in order to fulfil some planned goal.

Hence, this research investigates to what extent construction personnel feel innovative technology can stimulate building production to ensure that building projects are completed

within timeframes and budgets and what issues influence a construction firm's decision to invest in innovative technologies.

Innovative technologies considered in this article are building information modelling (BIM), location awareness technology (LAT) and laser-scanners (point cloud data). In South Africa the construction industry seems reluctant to deviate from their traditional ways of delivering construction projects, consequently the tendency is for construction managers to continue with traditional 2D and 3D drawings (Venkatachalam, 2014). It is believed that BIM technology can be a catalyst for change, with information replacing documents and knowledge becoming an asset. BIM is seen as an emerging technology that is globally accepted in the construction industry with its application gaining momentum. In order for BIM technology to be effective in the South African construction industry BIM standards need to be introduced in various policy frameworks of statutory councils and government agencies.

2 Literature Review

Tah (2012:354) acknowledged that knowledge-based decision support in project management has been slow to make an impact in the construction industry. According to Hardie (2010:387) the international construction industry has not adapted quickly enough to both new technologies and new management practices. The lack of responsiveness to more broad-minded management methods has led to many construction firms lagging behind in new management techniques and the use of technology. Hardie believes there is a desire by governments to support management strategies that inspire to continuous improvement and innovation. Lim and Peltner (2011:283) state that the significant improvement of technology in recent times has encouraged construction firms to invest in these innovative ways to improve their competitiveness. Isikdag (2012:385) clarified that BIM momentum is now changing the architecture, engineering and construction (AEC) industries in a way which is likely to cause a change in the general construction process, toward intelligent construction and intelligent buildings.

2.1 Building Information Modelling

Visual representation of a construction site is becoming useful using technologies such as BIM with 3D modelling capability that supports a wide range of construction management tasks such as construction planning, constructability review and site layout planning. Furthermore real-time position measurements during construction can assist in facilitating a variety of construction tasks at an operational level. Kim *et al.* (2005) suggests that using laser-scanning technology to produce point cloud information can also be useful for rapid on-site spatial-modelling. Whyte *et al.* (2007) describes virtual reality as an emerging design support tool that can manipulate in real-time and be used collaboratively to explore different stages of the construction process. Eastman *et al.* (2008) believes BIM is the most promising development in the construction industry today.

The main advantage of using BIM is efficient team work, better collaboration and better coordination and automated information management processes. Woudhuysen and Abley (2004:3) believe that construction has approached critical mass as far as the understanding of building modelling by senior technical and managerial staff. However, there are many difficulties being encountered by pioneering teams. Isikdag *et al.* (2008) goes on to describe BIM as a major innovation in technology that can assist with problems related to interoperability and information integration. However Isikdag *et al.* reminds us that an alteration in existing building processes inevitably incurs risk. Risk management is important when considering new technology including factors such as cost, who will be affected and who will be accountable. Furthermore Zawdie (2012:20) believes that innovation does not take place in a vacuum and that the culture within institutions requires a shift which introduces the

necessary flexibility for a generation of new ideas. One aspect identified as important for progress in BIM is the need for standardisation.

Venkatachalam (2014:144) stated that the adoption of BIM in South Africa and other developing nations is slow because of socio-economic factors. Venkatachalam believes that despite the numerous benefits of using BIM, challenges still remain in its implementation. Kiprotich (2014:43) revealed that construction firms in South Africa have shown significant interest in BIM since the turn of the new millennium. Kiprotich (2014:15) stated however, that contractors are concerned that BIM blurs the distinction between design and build. Kiprotich indicated that intellectual property also becomes an issue considering that BIM is a collaborative tool. Bengtson (2010) (cited in Kiprotich, 2014:35) indicated that the perception in the construction industry in South Africa is that BIM capability is overrated and this poses the greatest challenge. Although BIM can hold vast amounts of information, it requires additional expertise to manage large data sets. Kiprotich (2014:35) pointed out that regardless of the fact that computer hardware and software are developing quickly, big BIM projects become overloaded and slow down the model.

Porwal and Hewage (2013) (cited in Venkatachalam, 2014:146) indicated that BIM is now being widely used in countries such as the United States of America, United Kingdom, Australia, Hong Kong and Canada. Venkatachalam believes that it depends on the readiness of the industries as to whether they adopt this technology. Venkatachalam went on to say that government and regulatory bodies need to exert a greater influence towards the use of BIM. Venkatachalam believes that the South African construction industry is reluctant to deviate from their traditional ways of delivering construction projects. Thus the tendency is for construction managers to continue with traditional 2D and 3D drawings. Venkatachalam's study revealed that affordability and lack of knowledge are a hindrance in the adoption of BIM. Furthermore, people-related readiness is generally inadequate. Barlish and Sullivan (2012) (cited in Mutale, 2014:136) believe that the challenges in the implantation of BIM are; that benefits may be vague; the cost of introducing a new system; possible conflict between stakeholders; fear of the new system; and its effect on jobs.

2.2 *Laser-scanners and point cloud data*

According to Gleason (2013:2) laser-scanning in the construction industry has mostly been used to model existing structures from point clouds, nevertheless point clouds are now being used for many different applications relating to construction work. Point clouds can be applied in building process monitoring, used within BIM (Tuttas *et al.*, 2014:341). Gleason clarified that once the fieldwork has been done the entire individual scans are adjusted and orientated together so that the object model creation process can be done. Gleason goes on to say that the 3D model created from the new data provides enormous opportunities. However there are constraints when using point cloud data which must be considered. The processing of 3D laser scans requires a lot of computer power that will halter the processing of huge data volumes. Gleason noted that scanning can be a time consuming endeavour, resulting in very large and complex datasets. Gleason cautioned that scanning technology projects must be well planned. Attempting to recreate every single element in a single area can lead to loss of focus and failure to meet the broader objectives. Attempting to capture smaller elements is often impractical and unnecessary. Gleason acknowledged that these tolerances can be set in the scanning hardware, to regulate the laser beams; such settings are known as the resolution and quality setting.

2.3 *Location Awareness Technology*

It has been ascertained that, considering all the activities on a congested construction site, space management becomes the most important task (Tommelein & Zouein, 1993; Spillane *et al.*, 2011:143). Yun-Yi Su (2010:1) explained that innovation using LAT technologies assists in

all stages of building production and supports important decision-making tasks in the field. Razavi *et al.* (2012:239) explained that location awareness is needed for decision-making and for tracking progress. Health and safety can also be improved using LAT. The challenge is that LAT has been less than satisfactory for inside measurement but rather outdoor environments. The obstruction of signals by buildings and tree canopies places limitations on the outdoor tracking ability of a global positioning system (GPS). Satellite technology cannot receive radio signal inside a building. Recent developments in indoor location sensing systems have overcome this limitation by using radio frequency identification. This offers significant potential on construction sites. However a wide range of protocols need to be followed for indoor location systems to be sufficiently accurate.

3 Research Methodology

The research method is both quantitative and qualitative using surveys for data collection. This type of research aims to record an accurate and adequate description of the problem statement and the sub-question. Data for the study are collected through observations, semi-structured and unstructured qualitative interviews and quantitative close-ended questionnaires administered to construction stakeholders working in the Western Cape Province, South Africa. This research focuses on the City of Cape Town to gain an understanding of the dynamics of innovation in building production processes within the building industry. The population of this research include building project managers, registered contractors as well as consultants. Quantitative data obtained from the structured questionnaire design was analysed with descriptive statistics, Statistical Package for Social Science (SPSS) software 21 and content analysis are used to analyse the qualitative data obtained through interviewees.

The scope of the study is limited to the personnel working on construction sites in the City of Cape Town's urban centres. This study was conducted over three distinct phases. The first phase involved a pilot study which employed qualitative data-gathering techniques to orientate the researcher with regard to the study, and to modify and debug the process, with the expected result being a smooth run for the main enquiry. The second phase of the study establishes to what degree building construction personnel currently involved with building construction projects believe BIM, LAT and laser-scanners are useful during building construction and what issues influence a construction firm's decision to invest in innovative technologies. The third phase entailed the interpretation and validation of data.

The population included personnel in the building construction industry that are currently involved in managing building projects in the central business district of Cape Town. These personnel include: Architect (2), Contracts Manager (10), Engineer (28), Facilities Manager (2), Forman (7), Laboratory Technician (1), Project Manager (12), Consultant (6), Quantity Surveyor (33), Site Agent (7), Junior Contracts Manager (1), Junior Engineer (2), Junior Quantity Surveyor (16), Site Supervisor (1), Surveyor (7) and Technician (4), the total sample being 139.

The majority of respondents (69%) were below the age of twenty six years with the balance (31%) above twenty six years. Respondents with a matric certificate represented 17% of the total sample while respondents with a National Diploma in construction management or equivalent represented 52% of the total sample. Respondents with a Bachelor Degree in construction management or equivalent represented 31% of the total sample. Respondents were employed by a variety of construction business companies/enterprises. These included architectural firms (3%), construction companies (60%), facility management firms (1%), government departments (2%), project management firms (7%), quantity surveying practices (22%), real estate companies (1%) and sub-contracting companies (4%). The majority of respondents were employed by construction companies.

4 Findings and Discussion

The pilot study revealed that respondents felt BIM, LAT and laser-scanning can have a big impact on improving current building production processes and is extremely useful technologies. Respondents believed that BIM is effective from the design stage, into construction and beyond. The respondents agreed that a database-driven model, such as BIM, would be beneficial on site, where project managers and quantity surveyors can count, cost and order material, based on updated real-time information. Furthermore, respondents felt that BIM would be useful for programming, construction sequencing and would reduce mistakes on site. Although some of the respondents described BIM as a just another documenting system, others felt that its use integrates engineering and facilitates collaboration between professionals.

Respondents agreed that laser-scanners are becoming more practical on construction sites. Respondents felt digital engineering should be encouraged at universities so as to produce industry leaders in this regard. Respondents felt that the production of point cloud information through laser-scanning technology provides a vast pool of information about as-built structures. Laser scanners provide point cloud information that can be used to interpolate information between designs and help structural engineers, architects and construction engineers to process, visualise and synthesise design and construction more clearly.

Respondents explained that LAT uses several radio technologies that supply wireless connectivity. This technology is being explored in shopping malls where retailers are experimenting with achieving deeper customer engagement by helping them find the precise location of products and staff. Respondents felt the construction industry can actively deploy these solutions to address factors that affect construction in urban centres such as the management of congested space, locating materials, managing restricted access for delivery of materials, safe movement of materials, health and safety issues, communicating, coordination management and increased resource and personnel management. This survey suggests that the use of LAT is generally used during the executing and monitoring stages in the building production process, however, the true success of implementing LAT on construction sites will only materialise with innovation and the discovery of new applications, which will be either stand-alone applications or in combination with other technologies.

With regard to the issues potentially influencing a construction firm's decision to invest in new technology on building construction projects the pilot study revealed that cost, leadership, risk, logistics, training of personnel, lack of knowledge regarding technology, experimental time, sharing information and technology development were issues to be considered.

The second phase of this research consisted of two objectives, the first objective was to investigate to what extent construction personnel feel innovative technology such as BIM, LAT and laser scanners can stimulate building production. The second objective establishes what issues most influences a construction firm's decision to invest in innovative technologies. Respondents were asked to indicate their response using a five-point scale, 1 = 'not at all', 2 = 'sometimes', 3 = 'often', 4 = 'generally' and 5 = 'almost always'. Some respondents failed to answer all the questions on the questionnaire. This was because some were unfamiliar with the technology and did not know its usefulness during that stage of a building construction project.

Table 1. The usefulness of innovative technology during a construction project

	Number of responses	Not at all (%)	Sometimes (%)	Often (%)	Generally (%)	Almost always (%)	No response (%)	Mean	Std. Deviation	Rank
Initiating stage of a construction project										
BIM	120	8.6	8.6	18.0	18.7	32.4	13.7	3.7	1.34	1
Point Cloud	121	23.0	17.3	17.3	13.7	15.8	12.9	2.8	1.45	2
LAT	122	28.1	19.4	18.7	11.5	10.1	12.2	2.5	1.36	3
Planning stage of a construction project										
BIM	125	5.8	5.8	10.8	21.6	46.0	10	4.1	1.21	1
Point Cloud	118	22.3	14.4	13.7	20.1	14.4	15.1	2.9	1.46	2
LAT	120	29.5	14.4	14.4	15.1	12.9	13.7	2.6	1.48	3
Executing stage of a construction project										
BIM	118	8.6	7.9	20.1	27.3	20.9	15.2	3.5	1.25	1
LAT	120	16.5	14.4	15.1	23.7	16.5	13.8	3.1	1.41	2
Point Cloud	121	17.3	12.9	24.5	18.7	13.7	12.9	3.0	1.34	3
Monitoring stage of a construction project										
BIM	120	5.0	12.2	18.7	27.3	23.0	13.8	3.6	1.19	1
LAT	121	19.4	12.2	18.0	18.0	19.4	13	3.1	1.46	2
Point Cloud	120	18.0	15.1	23.0	15.8	14.4	13.7	2.9	1.37	3
Closing stage of a construction project										
BIM	118	8.6	10.8	19.4	23.0	23.0	15.2	3.5	1.29	1
LAT	117	25.2	16.5	19.4	10.1	12.9	15.9	2.6	1.42	2
Point Cloud	120	25.2	23.0	15.8	8.6	13.7	13.7	2.6	1.41	3

The results presented in Table 1 show that participants felt BIM technology ‘almost always’ enhance building production process during the initiating and planning stages of a construction project, furthermore BIM technology was considered as ‘generally’ beneficial during the execution, monitoring and closing stages of a building project. Laser-scanners and point cloud data was considered not useful during the initiating, planning and the closing stages of a project but considered useful during the executing and monitoring stages. LAT technology was only considered useful during the executing and monitoring stages.

The second objective of this study was to investigate why construction firms are reluctant to invest in innovative technologies such as BIM, LAT and laser-scanning technologies. The study showed that the cost of implementing new innovative construction methods is almost always a factor (Table 2). Risk, logistics, personnel training and a lack of knowledge significantly influenced a firm's decision to invest in new innovative construction methods, whereas experimental time, sharing information and technology development is more often than not a factor. The study also revealed that strong leadership is often needed to adopt innovative methodologies for new strategic management methods on construction sites.

Table 2. Issues that influence a construction firm's decision to invest in innovative technology

	Number of responses	Not at all (%)	Sometimes (%)	Often (%)	Generally (%)	Almost always (%)	No response (%)	Mean	Std. Deviation	Rank
Cost	138	3.6	5.0	18.0	22.3	50.4	0.7	4.1	1.10	1
Strong leadership	138	5.8	12.2	26.6	23.0	31.7	0.7	3.6	1.21	2
Risk	138	3.6	18.0	23.7	30.9	23.0	0.8	3.5	1.14	3
Logistics	138	3.6	15.8	30.2	33.1	16.5	0.8	3.4	1.06	4
Training personnel	138	6.5	17.3	24.5	29.5	21.6	0.6	3.4	1.20	5
Lack of knowledge	138	10.8	14.4	23.7	29.5	20.9	0.7	3.4	1.27	6
Experimental time	138	4.3	13.7	45.3	22.3	13.7	0.7	3.3	1.01	7
Sharing information	138	11.5	16.5	33.1	23.0	15.1	0.8	3.1	1.21	8
Technology development	138	8.6	23.0	39.6	18.0	10.1	0.7	3.0	1.08	9

5 Conclusion and Further Research

Innovative technology is an effective management tool for building production in urban centres to improve building production workflows. The construction industry in South Africa seems to be reluctant to invest in innovative technology for building construction projects. The biggest obstacle a firm faces when making a decision to invest in innovative technology is cost of equipment and training. Furthermore, weak leadership was found to influence a firm's decision to modernise. Risk, logistics and training of personnel are all issues that a firm needs to consider. The lack of technological knowledge, experimental time, sharing of information and technological development are also influential. The use of technology is proving to be useful during all stages of building construction. BIM is an emerging technology that is globally accepted in the construction industry and is gaining momentum. The BIM trend in African is progressive with building construction personnel in Cape Town believing BIM should be used extensively during the initiating and planning stages of a project. BIM needs to be utilised to its full potential and be supported through various policy frameworks by different stakeholders of the AEC sectors such as the statutory councils and the government agencies. The staged adoption of BIM and a new policy framework in the South African AEC sector need to be put in place. BIM technology is applicable throughout all process in building construction management. BIM technology allows the project to be seen within the context of the system it will operate in. The convergence of building production methodologies and technology is allowing better management of information.

6 References

- Eastman, C, Teicholz, P, Sacks, R. and Liston, K (2008). BIM handbook - A guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors. Chester, UK: John Wiley and Sons, Ltd.
- Gleason, D (2013). Laser Scanning for an Integrated BIM. Paper presented at the Lake Constance 5D-Conference, 28th–29th of October.
- Hardie, M (2010). Influences on innovation in small Australian construction businesses. *Journal of Small Business and Enterprise Development*, Vol. 17(3), pp. 387–402.
- Isikdag, U, Underwood, J, and Kuruoglu, M (2012). Building Information Modelling. In Akintoye, A, Goulding, J and Zawdie, G. (eds). *Construction Innovation and Process Improvement.*, Pondicherry, India: SPi Publisher Services

- Kiprotich, C. J. K (2014). An Investigation on Building Information Modelling In Project Management: Challenges, Strategies and Prospects in the Gauteng Construction Industry, South Africa. Unpublished thesis.
<http://mobile.wiredspace.wits.ac.za/handle/10539/15492> Accessed on 17 April 2015.
- Kim, K.J, Lee, C.K, Kim, J.R, Shin, E.Y, and Cho, Y.M (2005). Collaborative work model under distributed construction environments. *Canadian Journal of Civil Engineering*, Vol. (32), pp. 299-313.
- Lim, J and Peltner, F (2011). Innovation performance of construction enterprises. An empirical assessment of the German and Singapore construction enterprises. *Construction Innovation*, Vol. 11(3), pp. 282–304.
- Mutale, L.P, Danstan, C, Tembo, C. K, Matipa, W & N’gandu, V. B (2014). Building Information Modelling (Bim): An Assessment of its Viability in Cost Management in the Zambian Construction Industry. Proceedings of the 8th Built Environment Conference, Building Information Modelling (BIM): An Assessment of its Viability in Cost, Durban 27–29 July 2014.
- Razavi, S.N, Montaser A, Moselhi, O (2012). RFID Deployment Protocols for Indoor Construction. *The Journal of Construction Innovation: Information, Process, Management*. Vol. 12(2), pp. 239 – 258.
- Spillane, J, Oyedele, L, Von Meding, J, Konanahalli, S, Jaiyeoba, B, and Tijani, L (2011). Confined site construction: A qualitative investigation of critical issues affecting management of health and safety. *Journal of Civil Engineering and Construction Technology*. Vol. 2(7), pp. 138-146.
<http://www.academicjournals.org/jcect> Accessed on May 2014.
- Tah, J (2012). Virtual Planning and Knowledge-based Decision Support. In Akintoye, A. Goulding, J and Zawdie, G. (eds). *Construction Innovation and Process Improvement*. Pondicherry, India: SPi Publisher Services.
- Tommelein, I.D, and Zouein, P.P (1993). Interactive Dynamic Layout Planning. *Journal of Construction Engineering and Management*. Vol. 119(2), pp. 266-287.
- Tuttas, S, Braun, A, Borrmann, A and Stilla, U (2014). A Comparison of Photogrammetric Point Clouds with BIM Building Elements for Construction Progress Monitoring. *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XL-3, pp. 341-345.
- Venkatachalam, S (2014). A Study on the various possible policy frameworks for the effective adoption of Building Information Modelling (BIM) in South African Architectural Engineering and Construction (AEC) sector. In Proceedings of the 8th Built Environment Conference, Durban, South Africa, pp. 144-154.
- Woudhuysen, J and Abley, I (2004). *Why is construction so backward?* West Sussex, England: Wiley-Academy.
- Whyte, J.K, Ewenstein, B, Hales, M and Tidd, J (2007). Visual practices and the objects used in design, *Building Research and Information*, Vol. (35), No. 1, pp. 18-27.
- Yun-Yi Su (2010). Construction crew productivity monitoring supported by location awareness technologies. Unpublished PhD thesis, Graduate College of the University of Illinois at Urbana-Champaign.
- Zawdie, G (2012). Construction Innovation through Change Management. In Akintoye, A. Goulding, J & Zawdie, G. (eds). *Construction Innovation and Process Improvement*. Pondicherry, India: SPi Publisher Services.

THE IMPACT OF LOAD SHEDDING ON THE CONSTRUCTION INDUSTRY IN SOUTH AFRICA

Coetzee, Drian; Els, Mart-Mari

Department of Quantity Surveying and Construction Management, University of the Free State, Bloemfontein, South Africa

Abstract

Eskom generates about 95% of electricity used in SA (Conradie & Messerschmidt, 2000). In 2008 (January) ESKOM introduced load shedding or planned rolling blackouts based on a pre-determined rotating schedule, in phases where short supply threatens the integrity of the grid. Demand-side management has concentrated on encouraging consumers with the aim to conserve power during peak periods in order to reduce the incidence of load shedding. The purpose of this paper is to establish the impact that load shedding has on a construction project specifically on the time and cost elements during construction. The methodology followed was to acquire usable support for the hypothesis through an in depth review of the literature that interprets and discusses the current knowledge on the subject matter, followed by structured interviews and two case studies. The findings of this study indicate that load shedding has a financial effect on a construction project and also influence the time. Therefore resulting in time and cost overruns on the project. Time and cost are therefore influence by the application of load shedding during a construction project. The value of this review reflects the impact of load shedding not only on a single construction project but on the construction industry as a whole. It is suggested that provision such as a specific clause in the contract or provision in the Preliminaries and General section of the construction contract should be made in future construction projects for load shedding to minimise and manage the impact of load shedding on the time and cost elements of the project.

Keywords: Load shedding, ESKOM, Construction industry, Cost overruns, Time overruns

1 Introduction

ESKOM is a South African (SA) electricity public company, established in 1923 as the Electricity Supply Commission (ESKOM) by the government of SA in terms of the Electricity Act (1922). The company is divided into Generation, Transmission and Distribution divisions. Eskom generates about 95% of electricity used in SA (Conradie & Messerschmidt, 2000). In 2008 (January) ESKOM introduced "load shedding", "planned rolling blackouts" based on a pre-determined rotating schedule, in phases where short supply threatens the integrity of the grid. Demand-side management has concentrated on encouraging consumers with the aim to conserve power during peak periods in order to reduce the incidence of "load shedding". However, it well known that load shedding is becoming more frequent in South Africa due to the low supply and high demand of electricity. ESKOM even apologised to the public of South Africa for the inconvenience due to load shedding. They also admitted that while the reserve margin being low, they do not have sufficient capacity to meet demand. This necessitating planned, controlled and rotational "load shedding", to protect the power system

from a total country-wide blackout. Alarming, a country-wide blackout is a strong probability. The first steps include requesting large consumers to reduce load voluntarily. However, if numerous power station units trip unexpectedly, ESKOM has to skip these steps and implement load shedding, this is to prevent the system from becoming unstable. Scheduled load shedding is measured by way of sharing the available electricity energy among all its customers.

By switching off parts of the network in a controlled manner, the system remains stable throughout the day, and the impact is spread over a broader base of consumers (Conradie & Messerschmidt, 2000).

There are three dimensions to the electricity problem faced in South Africa. First of all, capacity - According to Altman (2008:12) this capacity problem is initiated mainly by the difference between the connected (or operational) generating capacity and the peak demand of South Africa. One main solution is recommended, and that is on the supply side, to increase the capacity by new investment, and ESKOM's capacity resources, while on the demand side, to reduce the peak demand of consumers.

Secondly, supply - Altman (2008:12) also stated that the supply problem of electricity is caused mainly by a difference between consumption levels by the consumers and the ability to supply power from ESKOM. Unfortunately, a combination of operational capacity has to be increased and also the ability to run it over sustained periods by increasing the supply of power. It depends also upon technical requirements for maintenance which must be done regularly, and the availability of complementary inputs, as well as primarily coal that has to be increased. It also seems that in South Africa is there a constraint on production caused by the quantity and quality of coal supplies to ESKOM.

Lastly, the reserve Margin - Newberry (2007: Online) and Altman (2008:13) shows that the reserve margin problem in South Africa has been caused by the high demand for electricity which is faster than operational capacity of ESKOM. Therefore, less time for maintenance is available, and the equipment lifespan is shorter, which results in parts that have to be replaced and the electricity price increase. This also reduces the shield for unplanned down time of the electrical equipment, which leads to disruptions of supplies. However, all these problems can be solved in the future by increasing the capacity. The capacity problem, and the ability to meet unanticipated increases in demand of electricity, depends on the availability of coal for the output of electrical energy. When stocks of coal are exhausted, they can only be rebuilt if coal purchases exceed usage. This can only be achieved in part by reducing the electricity consumption from the consumers.

The purpose of this study is therefore to:

1. Explore the impact of load shedding on the construction industry with regards to time lost and cost when load shedding occurs.
2. Identifying the impact load shedding has on the building work but also lack of performance by the construction industry during load shedding.

Time and cost might be the "overruns" that influence the critical path of a project. Load shedding has become a recognized problem, thus by identifying the impact load shedding has on the industry; provisions can be made to address the current problem.

2 Literature Review

When the electricity crisis first arose late in 2007, ESKOM informed all municipal supply authorities and consumers that it required a 10% saving in electricity consumption. This was in order to maintain the stability of the national electricity grid while still allowing for a 4% growth in consumption annually. ESKOM placed a six month moratorium on the approval of

all power applications for new construction projects, which was supposed to have ended on 31 May (Greager, 2008). This moratorium by ESKOM applies to all new projects requiring an electricity supply exceeding 100 kVA.

As reported in the May issue of *Vector*, an Electricity Crisis Forum was established by Master Builders South Africa (MBSA), which includes all role players in the construction industry, including the Electrical Contractors Association of South Africa (ECASA). They appointed a smaller task team to allow role players to discuss and debate with ESKOM appropriate reactions to the electricity supply issues as they unfolded (Greager, 2008). Alarming, at the first meeting ESKOM representatives reminded the other delegates that ESKOM was formulating criteria and guidelines that would be used when considering applications for the provision of electricity supplies to new developments when the moratorium ended. However, it had now been decided that the moratorium would continue, and the quotations issued would merely reflect the cost of providing the new supply, and the time frames within which new supply could be provided. The South African construction industry was hard hit by the infrastructure development highs leading up to the 2010 FIFA World Cup, followed by a global recession and/or depressed growth. Detail statistics of the decline of the construction industry over the last three years have been well publicised (PWC, 2013). However, in 2013 the construction industry was also in the headlines for all the wrong reasons. The most notable headlines have been the finalisation of the Competition Commission enquiries as well as the significant delays at ESKOM power plant projects. All these negative headlines have highlighted the importance of the industry, not only for the country's development, but also the challenges of the environment in which it operates (PWC, 2013). According to PWC (2013) large capital projects are inherently risky as well as their multi-year timelines, changing requirements and complex procurement issues. All these require diligent oversight from the construction industries common concern for budget overruns and the effect on financial health. Kerzner (2001:5) emphasizes that project success includes "completion within the allocated time period, within the budgeted cost, with acceptance by the user/customer, at the proper performance and with minimum or mutually agreed upon scope changes". This paper will firstly identify the effect of load shedding on time in the construction industry, followed by the impact time has on the building process due to load shedding. The impact of time on the construction industry leads to multiple effects on the cost of the project. Secondly the researcher introduces the effect of cost in the construction industry, and the cost implication when time is influenced such as: Penalties for late completion: Late acquirement due to late completion of the building thus lost in income.

It is well known that "cost overruns and delays" have always been serious issues, but companies have recently become increasingly concerned about these elements since the recent economic uncertainty. PWC (2013: online), stated that even by correcting the course of capital projects, is the reality that mega-projects frequently exceed their budgets by 50% or more.

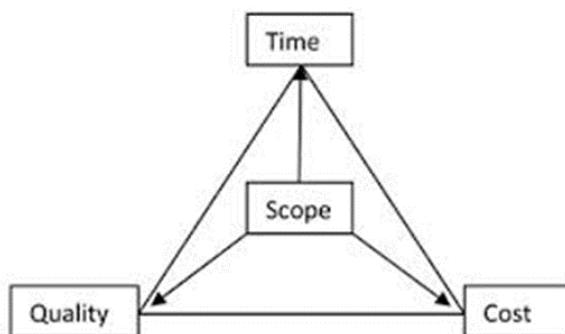


Figure 1. Four critical elements in Project Management (Source: Knipe, van der Walddt, van Niekerk, Burger and Nell, 2002: 18)

Figure 1 show that time is interlinked with cost, thus time lost during the construction equals loss of cost. When the time of construction is lengthened more resources should be allocated to the project to stay within the given time and budget. As seen in the figure quality are also affected.

3 Research Methodology

The methodology that follow is to acquire usable support for the hypotheses through an in depth review of the literature that interprets and discusses current knowledge on the subject matter, followed by qualitative research to test these theories on the effect of load shedding on time and cost in the construction industry. The research method that was applied is qualitative case study research approach. The case study was chosen because the growing problem of load shedding in South Africa, and to identify if this might have an impact on the construction industry. This is also an explanatory study and this has not been studied before in the Bloemfontein area. The case study is based on two construction sites (Project 1 and 2) in Bloemfontein, Free State Province, South-Africa.

The following inclusion and exclusion criteria for the research study were followed: The study is on the impact of load shedding on the construction industry (two commercial projects) in Bloemfontein, South-Africa. Yin (cited in Maree, 2007: 75) explained that a case study as a research method can be viewed as an empirical question that explores a modern phenomenon in a real-life context. The aim of this study and the structure of the research problem are as follows, with the research problem consisting of ‘what is the impact of load shedding on the construction industry in South Africa, with the following four research questions:

- What is the cause of load shedding in South Africa?
- What is the effect of load shedding on time during a construction project?
- What is the effect of load shedding on cost during a construction project?
- If load shedding becomes more frequent; what does this mean for the construction industry?

The views of relevant groups of role players are considered in case study research to obtain a deeper understanding of the dynamics of the situation (Maree, 2007: 75). In the qualitative research the authors makes use of purposeful/purposive sampling to gather information (Patton, 2002: 230). The author therefore conducted interviews with two experienced contractors (more than 10 years in the construction industry) in the Bloemfontein area. Friedmann (2011:18) explained that a contractor is exposed to the different elements during construction. This is why the focus group only consisted of two contractors in the Bloemfontein area. Established businesses and residential groups in the area were not interviewed, for the author believed that these groups would not make useful contributions to the research which focused on the impact of load shedding on the construction industry.

The researcher made use of a semi-structured interview protocol consisting of subjective open-ended and close-ended questions. The semi-structured interviews consisting of subjective open-ended questions were found to be effective in testing the propped objectives set in the study. Merriam (2009) explained that in semi-structured interviews all questions can be used flexibly, with specific data required from all the respondents. The largest part of the interview is guided by a list of questions or issues that needs to be explored. Coding the data also formed part of the data analysis and the interpretation of the results of the research. Coding is done to reduce the amount of data to manageable and understandable text, therefore enabling analysis and making sense of the data (Welman, 2005: 211-314). A pilot study with 1 contractor was conducted one month prior to the interview.

4 Findings and Discussion

Project 1

Project 1 is a commercial building consisting of multiple shops surrounding an anchor shop, including basement for parking purposes. The cost of the project is between R 40 000 000 – R 45 000 000 and the size is approximately 9000 m². The penalties amount is R 12 000 per day (Late completion) and the time of load shedding per week was about 2 hours (approx.) The scheduled amount of load shedding per week, 7.5hours (Assuming Stage 1). The contract period was 10 months but only finished after 23 months due to non-payment. A total of 690 hours of load shedding will occur according to the load shedding schedule.

Project 2

Project 2 is a commercial building consisting of luxury finishes with multiple buildings surrounding an anchor shop with high-suspended ceilings. The cost of the project is between R 42 000 000 – R 47 000 000 and the size is approximately 7000m².The penalties amount is R 5 000 per day (Late completion) and the time of load shedding per week was about 2 hours (approx.) The scheduled amount of load shedding per week, 7.5 hours (Assuming Stage 1). The contract period was 9 months. A total of 270 hours of load shedding will occur according to the load shedding schedule.

The following questions in respect of load shedding were asked to the contractors involved in these two projects. The purpose of these questions are to establish the effect of load shedding on critical elements (time and cost) of a construction project. Also to determine if there can be any provisions made for future projects in respect of the effect of load shedding.

4.1 Are you aware of the load shedding schedule?

Both respondents pointed out that they are aware of the load shedding schedule and were given a load shedding schedule for the project. They also added that there are numerous sources from where load shedding schedules can be obtained. The acquiring of a schedule was presented in a meeting in the first encounter when load shedding started becoming more frequent. It was obvious that both contractors were fully informed about load shedding schedules.

4.2 Is load shedding applied according to the schedule?

Both respondents stated that load shedding was not always applied according to the schedule. Therefore, the load shedding schedule was not always checked during the projects due to the unreliability of the schedule. However, both contractors were always aware of the possibility of load shedding. McDonald (2008:4) in an earlier study found that most of the companies reported that they had little or no warning of outages and even when ESKOM had distributed the load shedding schedules, they were infrequently adhered to. A number of companies recommended that they would prefer to have one full-day deprived of electricity once a week rather than random outages. In this way they could accommodate their working hours in discussion with their employees. It is interesting to note that both respondents indicated that they had not bought generators for emergency, or were planning to do so, because of the generator costs ranging between R100 000 and R500 000. Respondents to the survey by McDonald (2008: 4) also indicated that a waiting time from generator suppliers of between two to four weeks. Those answering towards the end of the survey period reported that the waiting period had increased to between eight and twelve weeks. It is understood that the waiting period is considerably longer now.

4.3 What is the average time of load shedding experienced per week?

The respondents indicated that the estimated amount of load shedding per week was two to three hours. The respondents also indicated that the load shedding schedule was unreliable and that load shedding occurred without warning or according to the schedule.

Confirming the results in a previous study that illustrates 85% of the BDO Company respondents stated the average period of load shedding is two to four hours. ESKOM (2015: Online) stated that most customers (those in two hour blocks) might therefore be without electricity for up to 2.5 hours at a time. Also depending on the stage implemented that week.

However, ESKOM (2015: Online) also stated that if more load needs to be shed than has been scheduled in Stages 1, 2, 3 and 4, the National Control will instruct additional, unscheduled load shedding. This means you may be shed outside of your scheduled times. However, both contractors indicated that they have an inexpensive generator on site for emergency, but they also mentioned that they do not plan to buy generators for back-up during load shedding periods. It seems that the cost factor and running cost of a generator outweighs the benefit of a generator.

4.4 Is there made use of generator on site for when load shedding occurs?

Both respondents stated that if you are a contractor in the construction industry, a high-quality, dependable generator is a vital asset to your business. Portable generators are the most commonly used generators at work site that can withstand the harshest of conditions and demands. However, they also mentioned that often times in larger, more difficult projects, a standard generator may not be your best option, especially if space is limited or the conditions can present a challenge. Both respondents confirmed that they do make use of generators on site but not for the purpose of load shedding alone, due to the high hire and operating cost. However, for one project (Project 1) the contractor relayed on a direct line of electricity and was vulnerable to the effect of load shedding. The contractor confirmed that this was an issue they had to deal with. Respondent two use a generator, but highlight again the extra cost involved. To conclude, it seems that for projects that are more heavy duty, you will need a generator that not only has a higher power output, but is built specifically for more demanding construction work. However, the cost of a “custom made generator” which fits construction operation needs exactly and the operating cost of a generator are currently just too high to compensate for the influence of load shedding on productivity as reported by the respondents.

4.5 Effect of load shedding on the project production process

One respondent detailed that due to the nature of the project (Project 1), of having a basement, load shedding delayed production to proceed as there was a health and safety risk of working in the dark. Respondent two mentioned that the load shedding have influenced the work significantly during high-suspended ceilings and multiple shop front installation. Olatunji (2010:15) in an earlier study concluded that time control concerns, and the effort made to the initial specified time of project are under serious constrains to finished the project in time. There are also various aspects of projects to be controlled human resources, health and safety, materials, machine control and maintenance (Olatunji, 2010:15). Both respondents highlight the importance of “health and safety” in their projects, and that load shedding plays a significant role even in the health and safety of the workers when they try to work in the dark.

4.6 Problem experienced when load shedding is applied

Respondent of project 1 has again highlighted all the problems they experienced when working in a basement of the building, stated that load shedding delayed production severely, and the health and safety risk of working in the dark. The respondent also elaborated that at their in-house manufacturing of construction equipment, a delay on the site arises due to load shedding,

and this equipment and material is dependable of electrical consumption. Both contractors also mentioned that the unprofessional conduct of time could have an adverse effect on the outcome of the project with respect to cost and quality if load shedding is not taken into account. The time taken to execute the project tasks from inception of site to delivery of the project is known as project duration (Olatunji, 2010:15). To concluded, the “project duration” is a vital variable in the cost of a project. The contractors mentioned that they are always under severe pressure because of these “deadlines” which they have to meet. Both contractors also highlight that it is not always possible to do “other” work during the time when load shedding is effected therefore load shedding influences the productivity of construction work.

4.7 Is the project on schedule?

Both respondents indicated that their projects is still on schedule, but if it exceeds the deadline the penalties amount will be between R5 000 (project 2) to R12 000 (Project1) respectively per day. They also highlight the fact, that for every minute they lost working time, they lose money. Ramabodu (2014:1) also mentioned that time is interlinked with cost, thus as the time of a project exceeds the estimated deadline this influences the cost of a project.

4.8 Provisions made for load shedding?

Interestingly, both respondents indicated that there was no provision made for the continuous load shedding on their construction projects. They mentioned again that the cost involved for a “custom generator” will be over R300 000, and the running cost of these generators is just too high.

Altman (2008:19) stated in this regard that the size of any impact that will shock the construction industry will depend on the time, over which it is measured, for numerous obvious reasons. Firstly, any increasing impact in time will be bigger if the periods become longer, to put it simply because it is cumulative. Secondly, and importantly for the construction industry the impact will be greater the more time there is for it to have knock-on effects (for the shock waves of load shedding to be felt through the construction industry).

One respondent also added that the construction teams do not take the relatively fast growing problem of load shedding into account. He highlighted the seriousness of the problem and his concerns “*If this problem of load shedding increases, provisions will have to be made not only on the time line but claims for time as well.*”

These results are aligned to the findings of a previous study by Von Ketelhodt and Wöcke, (2008:8) who indicate that 25.2% of manufacturing respondents strongly agree that load shedding influences the manufacturing process, the work process, and therefore the process duration. It is a fact that load shedding will increase, and provisions must be made not only for time lines, but also for claims if deadlines are not met.

5 Conclusion, Recommendations and Further Research

Based on the literature review it is acknowledged that one of the most common factor that contributes to load shedding is, historical bad assessments made by ESKOM. It is also expected that the reserve margin in electricity will continue to go on a downward trend for the next few years until there is a substantial power plant that can accommodate the demand of this new age. ESKOM admitted that with the reserve margin being low, they do not have enough capacity to meet demand, necessitating planned, controlled and rotational load shedding, to protect the power system from a total country-wide blackout.

Time and cost overruns in projects are problems that are almost always experienced in construction projects. However, while there is almost no clear way of avoiding time and cost overruns, there should always be proper planning to decrease the chances of these overruns occurring. As with load shedding, there is an element of probability in the occurrence of time and cost overruns. Load shedding may cause delays in time overruns and these can affect not only current projects, but will also affect future projects, as time constraints and adjusted deadlines affect their execution. Time is interlinked with cost, thus as the time of a project exceeds the estimated deadline due to load shedding, this might influence the cost of a project.

The aim of this study is to investigate the impact of load shedding on the construction industry in South Africa. In conclusion it is recommended that the construction industry considers the implementation of the recommendations mentioned in this paper. This might result in cost saving for the construction industry. The study revealed several limitations in various areas, which could be overcome in future research. The limitations include the following:

- To the researcher's knowledge, no studies relating to the influence of load shedding in the construction industry was done before, which made it really difficult to draw comparisons.
- The results of this study were based on data obtained from the Bloemfontein metropolitan only; therefore the results cannot be generalized to the other provinces in South Africa, as certain discrepancies may occur. It is recommended that future studies should be conducted to incorporate all the provinces of South Africa.
- This paper includes only case studies on commercial projects, which will be limited to commercial projects completed in the Free State province of South Africa. It is recommended that future studies should be conducted to incorporate all the other sectors in the construction industry in the different provinces of South Africa to establish the total impact load shedding might have.
- This paper is a "pilot" study, with a limited questionnaire. A comprehensive questionnaire must be developed to explore all the sectors in the construction industry which could be influenced by load shedding.
- Lastly, the research only explores what the effect of load shedding is on time and cost during a construction project. All the other project performance elements could be explored and the real time lost as well as cost could be determined as basis of a future study.

Further research can also be concentrated on contributions to delay in the delivery of projects by professionals in the industry.

6 References

- Altman, M. (2008). *The impact of electricity price increases and rationing on the South African economy*. United Kingdom: Department for International Development (DFID) initiative.
- BDO (2015). Citing References. [Online]. Available from:
<http://www.bdo.co.za/displaycontent.asp?contentpageid854> [Accessed 15 June, 2015].
- Conradie, S. R. and Messerschmidt, L. J. M. (2000).. *A Symphony of Power: The Eskom Story*. Johannesburg: Chris van Rensburg Publishers. p. 77.
- ESKOM (2015). Citing References. [Online]. Available from
<https://www.google.co.za/#q=ESKOM+load+shedding>: [Accessed 25 June, 2015].
- Friedmann, J. (2011). *Insurgencies: Essays in Planning Theory*". New York: Routledge.
- Greager, G. (2008). The electricity crisis and its effect on the construction industry in South Africa, June 11th. Published in Uncategorised articles.<http://www.ee.co.za/article/the-electricity-crisis-and-its-effect-on-the-construction-industry-in-south-africa.html>.
- Kerzner, H. (2001). *Project Management: A Systems Approach to Planning, Scheduling, and Controlling*. 7th ed. New York: John Wiley & Sons.
- Knipe, A.; van der Waldt, G.; van Niekerk, D.; Burger, D. and Nell, K. (2002). *Project Management for success*. Sandown: Heinemann Publishers.
- Maree, K. (2007). *First steps in research*". Pretoria: Van Schaik Publishers. Marquard, A.M. 2006. *The origins and development of South African energy policy*. Thesis (PhD). University of Cape Town, Cape Town., South Africa.
- McDonald, M. (2008). *Eskom load shedding seriously affecting manufacturing in the metal and engineering industries*. Insight, 2 April 2008, p.4
- Merriam, S. B. (2009). *Qualitative Research: A Guide to Design and Implementation*. San Francis co: Jossey-Bass Publishers.
- Newbery, D, & Eberhard. A, 2007. *South African Network Infrastructure Review: Electricity*
Citing References. [Online]. Available from:
<http://www.gsb.uct.ac.za/files/SAElectricityPaper08.pdf>: [Accessed 22 June, 2015].
- Olatunji, A. (2010). *Influences on construction project delivery time*. Degree Philosophiae doctor. Port Elizabeth .Nelson Mandela Metropolitan University.
- Patton, M.Q. (2002). *Qualitative Research and Evaluation Methods*. 3rd ed. London: Sage Publishers.
- PWC (2013). *Highlighting trends in the South African construction industry December 2013*.
www.pwc.co.za/en/assets/pdf/sa-construction-december-2013.pdf.
- Ramabodu, M.S. (2014). *Procurement guidelines for project success in cost planning of construction projects*: Degree Philosophiae doctor. Bloemfontein. University of the Free State.
- Thomas, J.R., Nelson, J.K. and Silverman, S.J. (2010). *Research Methods in Physical Activity*. 6th ed. America: Human kinetics.
- Von Ketelhodt, A. and Wöcke, A. (2008). *The impact of electricity crises on the consumption behaviour of small and medium enterprises*. *Journal of Energy in Southern Africa*, 19, 1.
- Welman, K.M. (2005). *Research Methodology*. 3rd ed. Cape Town: Oxford University Press.

AN EXPLORATORY STUDY INTO THE INFLUENCE OF SUPERVISORY REWARD TECHNIQUES ON CONSTRUCTION WORKERS PRODUCTIVITY IN BELLVILLE, SOUTH AFRICA

Opperman, Alvin Graham; Ndiokubwayo, Ruben

Department of Construction Management and Quantity Surveying, Engineering Faculty, Cape Peninsula University of Technology, Cape Town, South Africa

Nani, Gabriel

Department of Building Technology Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

Abstract

The aim of this paper is to assess to which extent current trends in supervisory motivational strategies can improve worker productivity through the use of reward techniques on construction sites. A qualitative approach was adopted by conducting a semi-structured interview to construction workers including bricklayers, plumbers, concrete workers, electricians and earthworks workers. The interviews were done in Bellville in the Western Cape at two conveniently selected construction sites. The data was analysed using content data analysis. Most prevalent in the findings of this study is the fact that the workers complained that a lack of intrinsic and extrinsic rewards negatively impacts their productivity. The intrinsic rewards techniques investigated was responsibilities and training. The extrinsic reward techniques investigated was salaries and bonuses. This research was conducted within the borders of the Western Cape Province of South Africa. Data obtained from only two construction sites, the exploration of other sites would have brought more insight into the subject matter. Data was only obtained from the construction workers, excluding their supervisors. This research has significance for contractors, supervisors and workers in terms of improving productivity. An increase in productivity of motivated workers results in an increase in contractors' revenue. Construction supervisors will reflect on their shortcomings in worker supervision, and gain more insight of the supervisory techniques and skills that will boost the productivity of their workers. Workers feel more relaxed in a conducive supervisory working environment; as a result, the increased productivity leads to financial rewards, and or promotion within their organisation.

Keywords: Motivation, Productivity, Rewards, Supervision, Trends

1 Introduction

Supervisors take up crucial positions in construction projects, because they are the channel through which management and the workforce do communicate (Unakweh, 2005). Thus, supervisors are regarded to be able to understand human behaviour and administer management principles (Catt & Miller, 1991). According to Dubrin (2005), supervisors plan, establish and regulate the project. The supervisor will also assign and utilise resources within the construction company in the quest of the targets set by the owners. However, supervisors get tasks completed through other people where a supervisor's elementary responsibility would be

to initiate decisions, designate resources, and more importantly direct the tasks of workers to reach company targets (Robbins, Odendaal and Roodt, 2006).

Mansfield and Odeh (1991) state that even with the advent of more sophisticated technology, the construction industry continues to be pre-dominantly labour intensive and this suggests that a proper emphasis should be given to such matters as communications, participation and motivation. Motivation has been defined as the cognitive decision making process through which goal directed behaviour is initiated, energised, directed and maintained (Buchanan & Huczinsky, 2000:40).

Olomolaiye and Ogunlana (1988) indicate that the construction environment in developing countries is different in terms of site organisation, quality of supervision, availability of production resource, and also is their socio-economic environment which produces a different worker; probably motivated by different factors. Also, it is a common appearance that workers in the construction industry have long been considered expenses, while stock, work in-progress, materials and structures are regarded on the balance sheets as assets (Dell, 1997:23). However, these days the adept employers are now becoming aware of the fact that construction workers are the assets of the company. Additional concerns are now contemplated as being less essential to the success of the company (Dell, 1997).

In 2004 it took the lowest paid worker within the construction sector 167 years to earn the average annual income of a CEO (LRS: online). At 2013 levels this has increased to 287 years, an increase of 71% when we compare the wage gap 2004 to that of 2013 (LRS: online) There is thus a trend in the widening of incomes and increasing inequality within the construction sector. This trend in the wage share within the construction sector, coupled with low level of real wage increases with profitability far outstripping wages and the huge increases in the wage gap all contributed to overall inequality in South Africa (LRS: online).

The general trend also has been for construction companies to down size their workforces to fewer core site employees. Subcontracting arrangements became increasingly popular with up to 70% of building and 30% of civil engineering projects subcontracted out (LRS: online). The majority of employers in the industry also rely on sourcing skilled people. The estimated composition of an onsite construction workforce is normally 50% unskilled, 26% semi-skilled, 19% skilled and 5% supervisory. This trend indicates that there is no real interest in the skilling of the vast majority of unskilled and semi-skilled workers who make up 76% of the general construction production process (LRS: online).

Therefore in order to better the construction workers productivity, worker motivational concerns must be determined and investigated (Doloi, 2007). Knowledge of these concerns and the befitting measures aids the construction industry in creating an efficient motivational environment to improve worker performance, job satisfaction, and to attain high construction productivity (Doloi, 2007). The most basic distinction of rewards is between intrinsic rewards and extrinsic rewards (Ryan and Deci, 1999). The objective of this study is to determine to which extent reward techniques influences productivity on a construction site.

2 Literature Review

2.1 Employee Rewards

Rewards spread far outside money into the array of non-monetary benefits. Fringe benefits would not be if money were all that is significant to workers. The reality of the business world is that money, fringe benefits, culture and leadership all make a motivational change because workers relate to them (Cox, Issa and Frey, 2006). For most workers a fringe benefit and a good old fashioned pat on the back can take the place of a few more rands, which helps explain why effective organisations offer worker benefits as well as encouragement. Different

incentives matter in different ways and in different amounts to different workers. It is management's job to identify and clearly comprehend what matters to their workers and what motivates them; then integrate that information into an incentives program that is effective and equally beneficial (Cox *et al*, 2006).

Therefore in order to keep construction workers motivated their expectancies must be addressed as project goals are reached. Satisfying workers expectancies can be viewed as distributing rewards when certain objectives are achieved. Employees have expectancies that they want to meet and employers have goals that they want to reach and they can work together as a team to satisfy the wants of both the employees and their employers. Workers who are motivated to help reach the goal of the employer and do so should be recognised with a reward. When considering what type of rewards to use there are two types to be aware of, intrinsic and extrinsic rewards (Cox *et al*, 2006).

2.1.1 Intrinsic Rewards

There are primarily two types of rewards. These are extrinsic and intrinsic rewards. Intrinsic rewards are positively valued labour outcomes that the individual obtains directly as a result of job performance; they do not entail the contribution of another individual or source (Pettinger, 2006:201). A sense of accomplishment after completing a particularly interesting task is an illustration of an intrinsic reward (Roa, 2009).

Therefore intrinsic motivation is that behaviour which an individual produces because of the enjoyable experiences related with the behaviour itself. Workers who are intrinsically motivated feel satisfaction in executing their work. This satisfaction may originate from any of several factors, including relishing the actual work done, the sensation of achievement, responsibility, meeting the challenges, etc. (Mosley, Mosley Jr. and Pietri, 2008). Supervising intrinsic work rewards offers the added challenge of planning a task so that workers can, in effect, reward themselves for a task well done (Pettinger, 2006). Providing constant training of construction workers aids in intrinsic rewards. Feelings of competence during task completion can enhance intrinsic motivation for that action allows satisfaction of the basic psychological need for competence (Ryan and Deci, 1999).

2.1.2 Extrinsic rewards

By comparison, extrinsic motivation is implemented not for its own sake, but rather for the consequences associated with it. Workers are motivated to perform at a high level only if they think that high performance will lead to outcomes such as salaries, job security, bonuses, or good working conditions (Mosley *et al*, 2008; Maurer, Weiss and Barbeite, 2003).

Supervisors can also offer a selection of extrinsic rewards, such as honest praise for a task well done, or figurative symbols of achievement such as worker of the month rewards, consist of low cost to the company (Schemerhorn, Hunt, Osborn and Uhl-Bien, 2005).

Salary is a particularly complicated extrinsic reward. It can help companies entice and hold on to vastly skilled workers, and it can satisfy and motivate these workers to work hard to attain high performance. But if there is unhappiness with the salary, salaries can also lead to strikes, grievances, absenteeism, turnover, and sometimes even poor physical and mental health (Schemerhorn *et al*, 2005). Table 1 reflects the differences in approach in reward strategies by Southern Africa countries against their global peers.

Table 1. Global and Southern-African trends in rewarding employees

Global approach	Southern-African approach
Companies follow a highly individualise towards managing compensation	A large proportion of South-African companies still struggle to find the correct link between individual performance and rewards.
Companies offer a wide variety of remuneration options customised to individual needs	Most companies grapple with finding the right balance between equitable rewards that acknowledge individual performance and achievement.
Companies extensively use IT in managing and administrating performance and rewards.	A large group of companies are still following a ‘one size fits all approach in managing rewards.
Most companies are able to measure performance accurately and effectively link it to rewards. World class companies measure high on performance and commitment.	In recent years, large companies have increasingly implemented flexible benefit plans.

(Source: Adapted from Robbins *et al.*, 2006)

According to Nicolaou, (1987) organizations can no longer depend merely on extrinsic rewards to motivate and reward their employees, as these employees are less eager to accept work that gives them little freedom, and they are not easily motivated by work that does not utilise their skills, abilities and education. Rosenbaum (1982) indicates that there are five action principles designed to help supervisors become effective people motivators, namely: a style of interacting with employees in ways that will maintain and enhance their self-esteem, active listening that shows understanding of and respect for employees.

3 Research methodology

An exploratory study was undertaken to determine the degree of motivational strategies used by supervisors on construction sites. The motivational strategy explored in this study was communication.

Two construction sites in Bellville, Cape Town were conveniently selected for the purpose of this study. The study was qualitative in nature and semi structured questionnaires were used to conduct the interviews. Biggam (2008) indicates that qualitative research is linked with exploratory studies. Two open ended questions were posed to the workers. The first questions asked the workers how management motivate them by using rewarding techniques such as salaries, bonuses, responsibility and training to motivate them. The follow up question was how the techniques used by the supervisor influences the workers’ productivity.

Five respondents from each construction site were interviewed. The respondents were selected by using purposive sampling. The purposive sampling method employed was maximum variation sampling or heterogeneous sampling, where the workers were purposively selected from various trades. The trades in which these respondents specialise in are earthworks, concrete, plumbing, bricklaying and electrical work. The data was analysed by using content data analysis.

4 Findings and Discussion

4.1 Demographics of respondents

A Total of 10 respondents took part in the study. The respondents were all male. The participants in the study as shown in Table 2 were mainly experienced workers. About 80% were in the construction industry for more than 5 years.

Table 2. Working experience

Years of experience	No	%
1-5	2	20
6-10	5	50
11-15	3	30
Total	10	100

Table 3 shows the status of the workers employers. 80% of the workers are employed by sub-contractors and 20% by the main-contractor.

Table 3. Employer status

	No	%
Main contractor	2	20
Sub-contractor	8	80
Total	10	100

Table 4 shows the skill level of the construction workers. 70% of the workers were unskilled, 20% semi-skilled and 10% skilled.

Table 4. Worker level

	No	%
Unskilled	7	70
Semi-skilled	2	20
Skilled	1	10
Total	10	100

Table 5 shows the trades of the respondents were involved in. The trades include bricklaying (20%), concrete (20%), plumbing (20%), electrical (20%) and earthwork workers (20%).

Table 5. Trades of workers

Trades of workers	No	%
Bricklayers	2	20
Concrete workers	2	20
Electricians	2	20
Plumbers	2	20
Earth workers	2	20
Total	10	100

4.2 Reward techniques used

The first question required the respondents to indicate whether the reward techniques used on site, in terms of salaries, bonuses, responsibilities and meaningful work motivated them towards higher performance. The different reward techniques are listed in Table 6.

Table 6. Frequency of use of reward variables (techniques)

No.	Variables	Yes		No	
		N	%	N	%
1	Salaries	10	100	0	0.0
2	Bonuses	2	20.0	8	80.0
3	Responsibility	1	10.0	9	90.0
4	Training	1	10.0	9	90.0

4.2.1 Salaries

In the study, all respondents (100%) stated that they receive their monthly salary. Salaries are an extrinsic reward. However, workers complained that monthly basic salary alone fails to motivate them to higher production levels. Actually the workers felt that salary increases are long overdue. Therefore (Schemerhorn *et al*, 2005) state that unhappiness with salaries can lead to strikes, grievances, absenteeism, turnover, and sometimes even poor physical and mental health.

4.2.2 Bonuses

In the study only 20% of the workers receive annual bonuses. Bonuses are an extrinsic reward. Furthermore 80% of the workers stated that they do not receive bonuses or any other form of reward from their employers. Workers actually indicated that they are reluctant to perform at higher levels, because they will not be rewarded for it. Mosley *et al*, (2008) and Maurer, *et al*. (2003) state that workers are motivated to perform at a high levels only if they think that high performance will lead to outcomes such as pay and bonuses.

4.2.3 Responsibility

In the study 90% of the respondents state that the supervisor, do not entrust them with the majority of the given tasks. Responsibility serves as an intrinsic reward (Ryan and Deci, 1999). The workers feel less empowered because the supervisor crowds them with his presence and will not let the workers take responsibility for some tasks. However, supervisors can boost expectancies through expressing confidence in their workers capabilities (Luthans, 2005).

4.2.4 Training

The study further indicates that 90% of the respondents complained that they do not receive any form of training to ensure that they can produce at higher levels. Training serves as an intrinsic reward (Ryan and Deci, 1999). The workers would like to excel in their various trades but are not given the necessary training in order for them to equip themselves. Jones (2009) states that supervisors can also boost workers expectancy levels and motivation by providing training so that people have all the expertise needed to perform.

4.3 Resulting productivity of construction workers

The follow up question asked whether these reward techniques used by supervisors improved the workers' productivity on site. The findings revealed that 80% of the respondents'

productivity was adversely affected by the rewarding techniques or lack thereof used by management. Workers indicated that management show little interest towards their empowerment. Workers feel that they need to be rewarded more in order for them to produce at higher levels.

5 Conclusion and Further Research

Supervisors are the link between management and the workforce. Therefore in order to gain sustainable productivity it is vital that the supervisor, through management, reward the workers to ultimately reach the organisation's ideals and goals.

The findings revealed that 80% of the respondents were working for subcontractors. The trend in this regard is towards outsourcing of the general workforce. In regards to extrinsic rewards the findings revealed the unhappiness of the workers towards their salaries, as they complained that their salaries were too low. The workers also complained about the absence of bonuses. In regards to intrinsic rewards, workers complained that supervisors do not give them enough responsibility. The workers also complained about the lack of training available to them.

The findings indicated that workers need both extrinsic and extrinsic rewards to better their productivity. The literature and empirical findings confirm the relevancy of Victor Vrooms expectancy theory. The theory indicates that motivation is at its peak when great levels of effort leads to performance and that performance gets rewarded with desirable goals (Mosley *et al*, 2008; Maurer, Weiss and Barbeite, 2003). Workers indicated the possibility of an enhanced performance at higher levels if there is an appropriate on job-training or feel that there may be no significant increase in reward for higher performance.

Further studies are recommended to determine how reward techniques can be properly designed to improve the productivity of construction workers.

6 References

- Buchanan, A.D. and Huczynski, A.A (2010). *Organizational behaviour*. Essex: Pearson Education Limited.
- Biggam, J. (2008). *Succeeding with your masters dissertation. A step by step handbook*. New York: McGraw-Hill Co., Inc.
- Catt, S.E and Miller, C. (1991). *Supervision. Working with people*. New York: Donnelly and Sons Company.
- Cox, R.F., Issa, R.R.A. and Frey, A (2006). Proposed Subcontractor-Based Employee Motivational Model. *Journal of Construction Engineering and Management*, 132(1), 152-163.
- Dell, T (1997). *How to motivate people, 2nd ed*. California: Crisp Publications.
- Doloi, H (2007). Twinning motivation, productivity and management strategy. *Engineering Management Journal*, 19(3), 30-40.
- Dubrin, A.J (2012). *Essentials of management. A strategic approach*. New Jersey: John Wiley & Sons.
- Jones, G.R and George, J.M. (2009). *Contemporary Management, 6th Edition*. New York: McGraw-Hill Co., Inc.
- Labour Research Service Bargaininig Indicators (2014). Twenty Years – A Labour Perspective. *Twenty Years of Transformation of the Construction Sector in South Africa since the end of Apartheid*. http://www.lrs.org.za/docs/BI2014-lowres_Chapt7.pdf [9 November 2015]
- Luthans, F. (2005). *Organizational behaviour. 10th Edition*. New York: McGraw-Hill Co., Inc.
- Maurer, T.J., Weiss, E.M. and Barbeite, F.G. (2003). A Model of involvement in work-related learning and development activity. *Journal of Applied Psychology*, 88(4), 707-724.

- Mansfield, N. R and Odeh, N. S (1991). Issues affecting motivation of construction Projects. *International Journal of Project Management*, 9(2) 93-98.
- Mosley, D., Mosley, D. Jr. and Pietri, P. (2008). *Supervisory management. The art of inspiring, and developing people*. Mason, OH: Thompson higher education.
- Nicolaou, S.C (1987). *Construction labour and productivity. Productivity improvements. Unpublished Masters Thesis*. New Jersey: New Jersey Institute of Technology.
- Olomolaiye, P.O. and Ogunlana, S.O. (1988). A survey of construction operative motivation on selected sites in Nigeria. *Building and Environmental Journal*, 23(3):179-185.
- Pettinger, R (2006). *Mastering organisational behaviour*. London: Palgrave publishers Ltd.
- Roa, V.S.P. (2009). *Organisational behaviour*. New Delhi: Excell Books.
- Robbins, S.P., Odendaal, A and Roodt, G. (2006). *Organisational behaviour. Global and Southern-African perspectives*. Cape-Town: Pearson Education, Inc.
- Rosenbaum, L.R. (1982). *How to motivate workers: Motivation models for managers and supervisors*. New York. McGraw-Hill Education.
- Ryan, R.M. and Deci, E.L. (1999). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology* 25, 54-67.
- Schemerhorn, J.R., Hunt, J.C., Osborn, R.N and Uhl-Bien, M (2011). *Organizational behaviour. International student edition*. New Jersey: John Wiley & sons, Inc.
- Uwakweh, B.O. (2005). Effect of foremen on construction apprentice. *Journal of Construction Engineering and Management*, 131(12), 1320-1327.

A FRAMEWORK FOR MANAGING CONTEXTUAL INFLUENCE ON HEALTH AND SAFETY IN CONSTRUCTION PROJECTS

Umeokafor Nnedinma

Department of Built Environment, Faculty of Architecture, Computing & Humanities, University of Greenwich, London, UK

Windapo, Abimbola Olukemi

Department of Construction Economics and Management, University of Cape Town, Cape Town, South Africa

Abstract

This study examines the construction environment in developing countries towards developing a conceptual framework for managing contextual influence on health and safety (H&S) in construction projects. This is on the grounds that the solution to the challenging state of H&S in developing countries depends on understanding the internal and external environment that construction contractors operate in. While the contextual environments of construction contractors in developing countries continue to receive little attention, according to literature review; the little attention does not proffer process-based solutions for companies. In filling the above gap, an existing framework in literature is modified, demonstrating how contextual influence on H&S can be managed in construction activities. This framework will enable organisations to identify the contextual factors (CFs) that will impact on H&S and rank the perceived impact, degree of dynamism, influenceability, producing the outcome of calculated level of awareness for proportionate attention. While identifying the CFs could significantly challenge the use of the tool, the level of awareness it creates puts the organisation that adopts it at the forefront of H&S management.

Keywords: Construction, Contextual factors, Developing countries, Health and Safety, Projects, Toolkit

1 Introduction

Noteworthy, the construction industry is among the most hazardous, and continues to record a high fatality rate (Construction Industry Development Board (cidb) 2009; Health and Safety Executive (HSE) 2014). Typically, in 2013/2014, the British construction industry accounted for 42 fatal injuries (32%) (the highest across all industries) and 32,000 new cases of work-related ill health (HSE 2014). In South Africa, a cidb (2009) report based on Department of Labour records shows an increase in fatal injuries of 52 in 2004/5 to 162 in 2007/8, making the construction industry the third highest per 100,000 workers among others.

While issues such as fragmentation of the industry (Kheni et al., 2005), remain among the generic and inherent causes of the poor H&S record in the construction industry, authors (Kheni et al., 2010; Umeokafor, 2015) strongly contend that in developing countries, the solution is in gaining insight into the internal and external environment that the construction contractors operate in (cf. International Labour Organisations (ILO) 2009). Albeit, the growing emphasis on integrating the internal and external environment of organisations into H&S strategies (ILO, 2009; Kheni et al., 2010; Umeokafor, 2015), it still receives low attention in terms of H&S

issues (Nuwayhid (2004) cited in Kheni et al., 2010) and even outside H&S (Ploesser et al., 2009). Studies that have examined the aforesaid have done well in creating the awareness and demonstrating their influence on H&S (for example Kheni et al., 2010; Umeokafor, 2015) but have not offered the methodological solution(s) to companies for controlling the influence of the environment on H&S.

Consequently, the main objective of this study is to examine the construction environment in developing countries towards developing a tool, which integrates the management of contextual factors (CFs) into H&S management throughout the entire construction project life cycle. First of all, literature on the characteristics of construction and contextual issues will be synthesised, and an existing framework in business management will be modified to produce a tool tailored to construction H&S that meets the above objective. Thereafter, the developed framework will be presented with an exemplary application in a construction process.

2 Literature Review

2.1 Characteristics of the Construction Industry

The characteristics of the construction industry offer possible explanations to the H&S challenges in construction projects. For example, the issues below contribute to the fragmentation of construction activities, resulting to H&S challenges, thus: subcontracting (Mayhew & Quinlan 1997); difficulty in ensuring alliance between major parties in contracts, including subcontractors (Vilacini et al., 2012); differentiation in terms of technology, cultural, and organisational grounds (Lingard, 2013), and complexity or the uniqueness of construction projects (Kheni et al., 2005). Indeed, the use of subcontractors has been linked to unsafe construction practices, which may be due to lack of clarity in roles and responsibilities among subcontractors, *inter alia*, complexity in subcontracting relationships (Mayhew & Quinlan 1997). Such characteristics of construction (or the industry) are also challenges to construction and the industry. While the literature demonstration so far is generic to the industry, receiving adequate attention; the environment of organisations, especially in developing countries also explains the poor H&S record and remains under-examined.

2.2 Integrating Contextual Factor Management into Health and Safety Management

2.2.1 Defining contextual factors

Although authors note the deficiency of an adequate definition of CFs in academic literature (Kronsbein et al., 2014), the conceptualisation of the concept in this study is informed by definitions in studies (for example Edwards & Steins 1999; Rosemann et al., 2006; Kronsbein et al., 2014; Umeokafor, 2015) or descriptions in studies such as Kheni et al. (2010). The definition that CFs are ‘...dynamic forces constituted in the user groups’ social, cultural, economic, political, technological and institutional environment...’ can be seen in Edwards and Steins (1999). According to Schmidt (2000) cited in Rosemann et al. (2006), the environment can be described as ‘the combination of all implicit and explicit circumstances that impact the situation of a process ... in which a business process is embedded’. This tends to be in agreement with other literature discussions of CFs in terms of H&S (Kheni et al., 2010; Umeokafor, 2015), but perhaps from an external context perspective. Therefore, adopting a broad conceptualisation of CFs, they are depicted in this study as dynamic forces within the internal and external environment of organisations influencing its activities, perception, beliefs and attitude. This is where the external environment includes the political, socio-cultural, socio-economic, technological, institutional, demographic, and legal context; and the internal environment relates to conditions or factors within an organisation such as organisational

culture, leadership approach. It is, however, possible that CFs correlate (see Banker and Natarajan, 2008; cited in Kronsbein et al., 2014; Rosemann et al., 2007).

2.2.2 Overview of previous studies on contextual factors

Despite the influence of the contextual environment on H&S in the construction industry, Nuwayhid (2004) cited in Kheni et al. (2010) decry the inadequate attention it receives. For instance, an author reports the adoption of H&S policies, *inter alia*, regulations from developed countries, but some are irrelevant or even impracticable in developing countries such as Nigeria (Aniekwu, 2007). This is because they have not been designed based on the contexts of these developing countries. Most of the imported regulations adopted are goal-based, but according to Umeokafor, (2015), developing countries such as Nigeria, lack the wherewithal.

In contrast to the premise of inadequate attention to CFs, studies have examined the contextual influence on businesses. For instance, while studies (Kronsbein et al., 2014; Ploesser et al., 2009; Rosemann et al., 2006, 2007) examine CFs from a non-construction perspective, Kheni et al. (2010) and Umeokafor (2015) examine CFs from a developing countries' construction industry perspective in terms of H&S. The latter two studies have mainly examined external CFs. For instance, Kheni et al. (2010) have identified the key contextual influences on H&S in Ghana and found that owners/managers of small firms in Ghana mainly engage in H&S practices due to their working relationship with their employees and not because of regulatory threats. In Nigeria, Umeokafor (2015) reports an appraisal of CFs where inadequate regulation ranks highest with relative importance index of 0.80, in addition to 43.5 percent of the participants opining that accidents are predestined.

However, while the studies above have created the awareness and made recommendations, they have not offered organisations practical guidance to managing contextual influences. Kheni et al., (2010) echo this while proffering solutions to the impact of contextual issues on H&S practices in Ghana's construction SMEs, recommending practical guidance for construction firms as one of the ways of overcoming the barriers. In other words, awareness of contextual influence or factors is not enough; therefore, to mitigate the effect of the CFs on H&S, organisations need practical guidance to controlling the factors. Thus, a step-by-step toolkit for managing the contextual influence on H&S is imperative. The framework in this study is developed to fill this gap, offering practical day-by-day or month-by-month solution and bridging the gap between theory and practice.

2.2.3 Context knowledge related studies

Models or frameworks relating to context-awareness in business process performance are significantly covered in literature but have some limitations. Saidani and Nurcan (2007) propose a four-step approach for supporting context related knowledge, consisting context elicitation, context categorisation, context adaptation and measure, and business process installation. Between the second and third steps is the context tree (CT), with which, in addition to a three-dimensional vector, context can be modelled and categorised. However, the complexity of constructing CT and valuing the context makes it arguably limited to only domain experts and a particular domain (Saidani and Nurcan, 2007), so its transferability to other domains is not possible (Kronsbein et al., 2014).

Rosemann et al. (2008) focus on integrating context into a process model, where the CFs cover internal context, external context, and intermediate context, advancing our understanding of contexts and their impact on businesses. However, the model concentrates on the classification of the different general layers of CFs, overlooking the different subgroups within each layer (Kronsbein et al., 2014).

Using context-awareness puzzle, Ploesser et al. (2009) argue that the pieces of the puzzle should be incorporated into process management for context-awareness. The puzzle covering context mining and learning, context modelling, context taxonomies for industries, and context-aware process operations is to be applied in the order of appearance (*ibid*). However, it tends not to be fully transferable to construction H&S because of the characteristics of the construction industry. It does not factor in the degree of dynamism of CFs. Also, the ability of organisations to influence CFs tends not to be incorporated in the puzzle.

A more robust work is presented by Kronsbein et al. (2014), discussing the various ways that CFs can influence an organisation, covering contextual influence at entire organisational levels, organisational process levels, and organisational activity levels. The work of Kronsbein et al. (2014) involves: first, assessing the impact of CFs; then the ability of the organisation to influence the factors is also assessed. This will then determine the required level of awareness of the factors after which the ‘degree of dynamism’ will be assessed and then the frequency for reviewing the entire assessment is determined.

There are, however, limitations to the work of Kronsbein et al. (2014), of which they acknowledge. Firstly, they have not provided any guidance for identification of CFs, which is very crucial to the model. Secondly, the scale of measurement (low, medium and high) lacks a clear distinction. Thirdly, although not acknowledged by Kronsbein et al. (2014), the method used in factoring in the ‘degree of dynamism’ of the CFs can be considered as inadequate. It can be argued that it should have been factored in at the upper stage of the framework where alongside the perceived impact on the organisation, it informs the influenceability (see: Figures 1 & 2). Finally, no guidance for assessing the perceived impact of the CFs on the organisations has been provided.

From the above, the following intents form the proposed framework in the current study: mining of CFs; impact of CFs on H&S at various stages of the construction project, with adequate guidance; degree of dynamism of the CFs; influenceability of the CFs factored in after the evaluation of the latter two; the awareness level of the CFs.

3 Research Approach

This study investigates the contextual influence on H&S in the construction industry. Literature survey was undertaken to demonstrate the gaps in knowledge and practice, and in modifying a framework in business management (Kronsbein et al., 2014), identified limitations were tackled and the framework tailored to construction H&S. The tool practically guides construction firms in managing contextual influence on H&S. An exemplary practical application was also presented in this paper. As the study is mainly of qualitative paradigm, prompting quantification of some aspects of the tool, it is subject to bias and subjective. Thus, opinions of 28 construction H&S experts were sought in validating the framework, by sending a detailed application of the framework to them between the second week of September 2015 and third week of October 2015. However, none signified interest or was in the position then to take part in the validation process up until the time of writing this paper. The experts were made up of 26 construction H&S experts in South Africa, 2 in Nigeria. However, the academic scrutiny that this paper has gone through during the peer-review process has provided academic validation to the research (Manu 2012). This is because peer-review processes involve professionals querying the content of a paper so as to make an informed decision as to if the paper will be accepted for publication or rejected (Manu 2012).

4 Development of the Process Framework

4.1 Overview of the analytical design

Figure 1 shows the newly developed tool for managing the impact of CFs on H&S in construction projects. This is guided by: $PI \times DD - IF = LA$. The CFs are identified and the perceived impact (PI) on H&S and the degree of dynamism (DD) are noted and evaluated [i.e. $PI \times DD$]. After the evaluation, the ability of the organisation to influence the contextual factor (influenceability (IF)) is then factored in to produce the level of awareness (LA). This will then determine the frequency of review and the action to take.

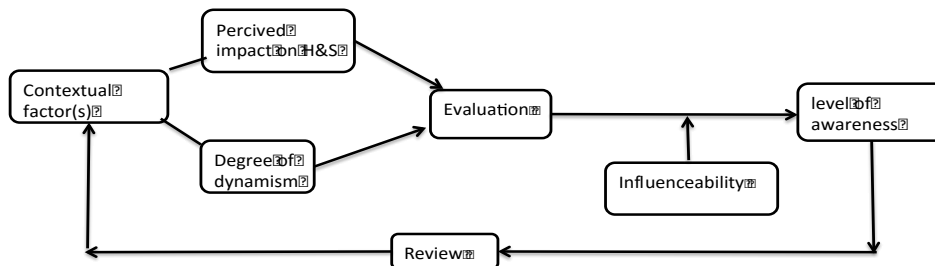


Figure 1. Overview of the framework (Source: Authors' conceptualization)

For this study, scales such as high (3), medium (2) and low (1), *inter alia*, have been adopted and a detailed guidance for measurement is presented. In H&S management, the tool can be applied at the various construction stages, construction processes and at various construction activities of the processes (Table 1). Table 1 details an exemplary application of the framework in an excavation process in a building project. It shows the identified context types, all in Figure 1 and how they are calculated. Figure 3 shows the application of the framework on a construction activity. The framework, however, is dependent on identifying the CFs, which may also be challenging but guidance is provided therein for the user.

4.2 Contextual factor(s): Mining of contextual factors

Although identifying CFs can be challenging (Edwards and Steins, 1999; Banker and Natarajan, 2008 as cited in Kronsbein et al., 2014) and its prediction difficult (Edwards and Steins, 1999), an attempt is made here to guide the users of the current framework on possible ways to identify CFs. A retrospective analysis in the case of contextual issues (Edwards & Steins 1999; Ploesser et al., 2009) on H&S data such as accident records, near miss records can outline the factors. This can also help predict possible outcomes in future events and behaviours of the factors (Edwards and Steins 1999) and even expose gaps in existing procedures (Ploesser et al., 2009). This is already commonplace in H&S for risk identification in areas such as risk assessment (see Windapo, 2013). However, what of the undocumented factors? This is where other ways of identifying CFs perhaps through the exchange of ideas among experts, consulting employees, employing the services of experts can come in. As earlier stated, these CFs can be framed under internal and external categories.

4.3 Perceived impact of contextual factor (PI)

After the mining of CFs in Figure 1, the perceived impact (PI) of the CFs will have to be ascertained. The PI of CFs on H&S is the implications of CF on H&S. Measuring the impact of CFs on H&S may be challenging, as there can be other contributory factors to the impact. However, it depends on the aspect of the impact that is considered. Going by the recommendation of HSE (2001) for measuring H&S performance, in the context of this study, the organisation should consider the following: the impact or contributory effects of the CFs on the hazardous activities of the organisations; the impact of the CFs on H&S management

systems; the impact of the CFs on ensuring positive H&S culture in the organisation, covering control, communication, competence and co-operation; and the contributory impact of the CFs to the accident, injury, ill health or fatality records.

From above, it is evident that the *PI* of *CF* on H&S can be based on lagging parameters such as accidents (see Sgourou et al., 2010). The *PI* of *CF* on H&S can also be based on leading parameters such as the impact on H&S management elements e.g. H&S audit (see Sgourou et al., 2010) ranking from high to low (Figure 2). For instance, for the lagging indicators such as injuries, the following scale can be used thus: high = fatality; medium = major injuries; low = minor injuries. For ill health, it can be high = more than 7 days out of work; medium = more than 3 days out of work, but below 7 days; and low if the days out of work is less than 3 days. For the *PI* in terms of leading indicators such as H&S management (e.g. H&S audit), which is subjective, the measurement below can be adopted. If the *CF* negatively impacts on H&S audit, resulting to no audit then the *PI* can rank high; if the audit is not thorough, the *PI* can rank medium; if the audit is good but with little limitations, the *PI* can be ranked low. This can be applied to the H&S culture context stated above.

4.4 Degree of dynamism (DD)

This stems from the constantly changing or developing phenomenon of the *CFs* (Edwards and Steins, 1999; Kronsbein et al., 2014). Highly contributory to determining the frequency of review, the points below indicate that this may be challenging to H&S, requiring adequate attention. Typically, as Figure 2 shows, it can rank from high to low. When it is ranked high, it poses a higher level of uncertainty and the likelihood of negatively impacting on H&S; thus, it requires constant attention. For instance, the inconsistency in the language of the casual workforce can be ranked high. However, when it ranks low, it does not pose the same level of concern, as it can be predicted to some extent. Additionally, a daily change in law is not possible so it can be ranked low. Any other *CF* of *DD* between the two examples above can be ranked medium. More importantly, the co-relationship among the factors and the continuum of the factors should be considered here.

4.5 Evaluation

This involves factoring in the *PI* of the *CFs* on H&S and the *DD* of the *CFs* before the ‘influenceability’ to make an informed decision (Figures 1 & 2). This is against Kronsbein et al., (2014) who consider the *DD* at the last stage to determine the frequency of review. The evaluation in the current tool stems from the premise that the *DD* of the *CFs* determines their criticality, as the likelihood of incidents is increased or decreased. As such, multiplying it with the perceived impact of the *CFs* before ‘influenceability’ (Figures 1 & 2) means factoring it in to present a better picture of the *CFs* (and their implications) to the organisation prior to considering their ability to influence the *CFs*.

4.6 Influenceability (IF)

The outcome of the above evaluation (in 4.5 and Figures 1 and 2) will inform the incorporation of the ability of organisations to influence the *CFs* (that is *IF*), providing the adequate level of awareness. For instance, the example in 4.4 (i.e. the inconsistency in the language of the casual workforce) may mean that the organisation can have a recruitment procedure where only workers that can communicate in the main language of most of the workers are employed. This means that they have influence power on the factor. As the *DD* is factored in before this stage, an informed decision can be made. The influenceability ranks from 1 to 3 with 3 being the highest. The instance above means that *IF* can be ranked 3 if the aforesaid recruitment strategy upholds across all potential workers. It can then be ranked 2 if the recruitment strategy is not applicable to all potential workers such as casual workers, perhaps, because of skills shortage

and/or that the available workforce is mainly of workers of different languages. Lastly, *IF* can be ranked 1 if it is not within the powers of the organisation to implement the aforesaid recruitment strategy, leaving it to fate. This will then inform the level of awareness.

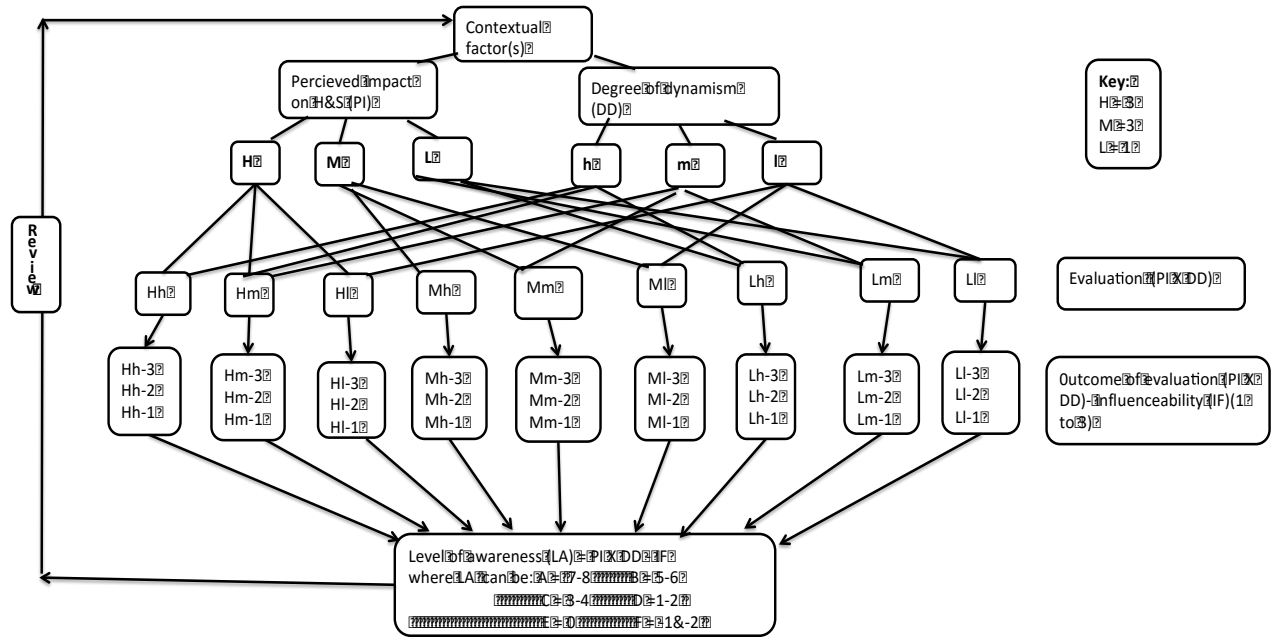


Figure 2. Detailed diagram of framework (Source: Modified from Kronsbein et al., 2014)

4.7 Level of awareness (LA)

As stated above, $PI \times DD - IF = LA$ is applied here, giving values ranking: A (7-8), B (5-6), C (3-4), D (1-2), E (0), and F (-1 & -2). ‘A’ shows the highest level of criticality and F the lowest. The value zero does not mean that the factor will be ignored, as it can still impact on H&S. Rather, it means that the level of attention it will receive will be lower than others that rank higher. When LA is E, it is negligible. LA throws the spotlight on the CFs as critical to achieving optimum H&S in construction projects. This provides a platform for organisations to channel adequate attention and resources to managing the CFs.

4.8 Review

This involves going through the entire process from the mining of CFs (Figure 2). This is highly informed by the LA, but DD may also be considered. Additionally, the characteristics of the construction industry make a case for constant review of the framework. Just as it obtains in the risk assessment exercise, a review of the framework may be conducted in events of, *inter alia*, a change of employee and/or work machinery.

5 Application of the Framework

5.1 Exemplary application of the tool to one construction project process

While Figure 3 shows a ground excavation process during the construction phase of a building project by a small and medium-scale enterprise in a developing country, Table 1 details the exemplary application of the framework in terms of Figure 3. It should be noted that the list of CFs in Table 1 is not exhaustive.

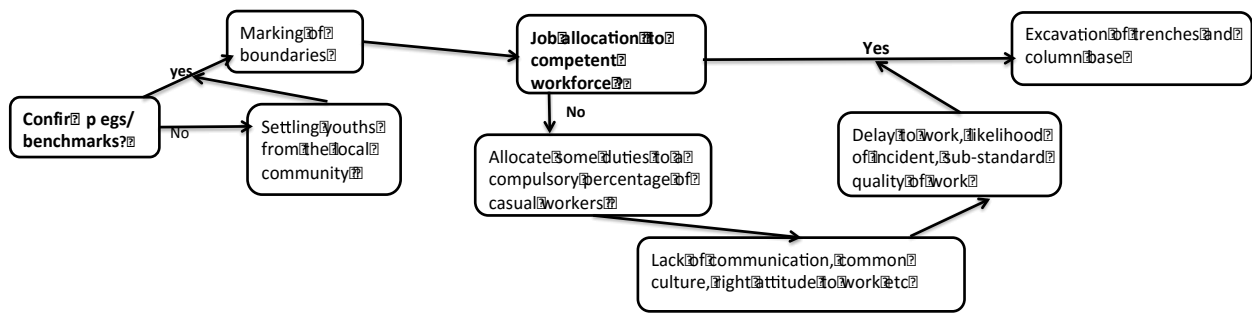


Figure 3. Selected activities in an excavation process in a building construction (Source: Authors' conceptualization)

Table 1. Tabular presentation of the application of the framework in Figure 3

Context layers	Context type	Example of contextual factor	Perceived impact of contextual factors on H&S (PI)	Degree of dynamism of contextual factor (DD)	Outcome of evaluation of PI X DD	PI X DD - Influenceability	Level of awareness
Internal	Organisational	Organisational structure	High	Medium	3 x 2 = 6	6 - 1 = 5	B
	Resource related	Training & skills of the workforce	High	High	3 x 3 = 9	9 - 1 = 8	A
External	Political	Inadequate governmental policies	Medium	Low	2 x 1 = 2	2 - 1 = 1	D
	Economic	Implication of incident and delay in work	High	High	3 x 3 = 9	9 - 1 = 8	A
	Cultural	Owner/manager and workforce relationship	High	Medium	3 x 2 = 6	6 - 3 = 3	C
	Social	Compulsory requests from community	High	High	3 x 3 = 9	9 - 1 = 8	A
	Technological	Unavailability of alternative equipment	High	low	3 x 1 = 3	3 - 1 = 2	D
	Environmental	Extreme weather	Low	Low	1 x 1 = 1	1 - 1 = 0	E
	Legal/institutional	Inadequate regulation of H&S and laws	High	Low	3 x 1 = 3	3 - 1 = 2	D
	Industry related	Lack of cohesion among workers	High	Medium	3 x 2 = 6	6 - 2 = 4	C

Source: Template modified from Kronsbein et al. (2014)

If not for the challenges of settling the youths and allocating some of the duties to the percentage of compulsory casual workers as specified by the community/contract, the excavation (Figure 1) would have been without any problems. Indeed, a site engineer on arrival on site to confirm the pegs and benchmarks of the already conducted setting-out activity before the commencement of work finds that there are youths of the community waiting for some unofficial apparent customs to be performed (see Figure 3). The youths were later paid off, thus increasing the project cost, delaying the work, in turn, affecting the allocated funds to H&S.

If there were adequate functional governmental policies protecting construction activities, such may not have happened. In this case, it is ranked 'medium' as it does not directly impact on H&S and ranked 'low' in terms of DD, as it is unlikely to change (Table 1). Its degree of influenceability is low (Table 1), as the organisation cannot influence the inadequate governmental policies. It also has a 'D' level of awareness, which is not critical. Internal factors such as skills of the casual workforce are considered to impact highly and directly on H&S; the

DD for the excavation process is also ranked high because of the inconsistency in the workforce (Table 1). Its influenceability is then ranked ‘medium’, as the organisation cannot afford to employ the workers permanently. In addition, they can negotiate with the community on the percentage of compulsory casual workers to employ. This is an instance of correlation with other factors, as it is influenced by the social factor in Table 1 that also ranks high. This is as a result of the community insisting that a certain percentage of the workforce be employed from the community, prompting differentiations in workforce attitude, language, culture to work, causing, *inter alia*, incidents, and delay in work (Figure 3). This, in turn, impacts on the organisation economically, ranking high in terms of the PI and high in terms of DD, as it varies depending on the cost due to the delay or incident (Table 1). The organisation can train the workforce on H&S and even try to instil common work culture, but all depends on the constituency of the workforce. Thus, it is ranked low with ‘A’ level of awareness, which is critical. The LA and the points in the ‘review’ subsection (4.8) inform the frequency of review.

6 Conclusion

A framework for managing CFs throughout the project lifecycle of construction projects is developed and applied in a construction process in the reported study. This stems from the premise that the impact of contextual issues on H&S remains highly underexamined, leaving organisations with no guidance to managing the contextual impact on H&S. The framework is made up of mining of CFs, then the perceived impact of the factors and the degree of dynamism are ranked. This is followed by factoring in the latter two in an evaluation process before the ability of the organisations to control the factors is considered. This takes us to the level of awareness enabling the organisation to channel adequate attention and resources to the factors. The review process is the last activity. Efforts are made in this study to guide the users of the tool to make a clear distinction in the scale of measurement of the tool. Identifying CFs may limit the efficacy of the tool, but the guidance in this paper can help overcome it. While this study may be subjective requiring a real life application, steps such as the academic validation of this paper reduces the level of subjectivity. It also, however, provides a stepping-stone to managing contextual influence on H&S on construction projects. As such, this framework can be validated in future studies based on a case study research approach. Also, areas such as the impact of the interaction among the CFs and their impact on H&S can be examined in further studies.

7 References

- Aniekwu, N. (2007). Accidents and safety violations in the Nigerian construction industry. *Journal of Science and Technology*, 27(1), 81 – 89.
- Construction Industry Development Board (2009). *Construction health and safety in South Africa*. Retrieved on 12-12-14 from http://www.cidb.org.za/documents/kc/cidb_publications/ind_reps_other/ind_reps_construction_h_s_in_sa_status_recommendations.pdf
- Edwards, R. D. J., Davey, J. and Armstrong, K. A. (2014). Profiling contextual factors Which Influence Safety in Heavy Duty Vehicle Industries. *Accident Analysis and Prevention* 73, 340-350.
- Health and Safety Executive (HSE, 2001) *A guide to measuring health and safety performance*. Retrieved on 22-09-15 from <http://www.hse.gov.uk/opsunit/perfmeas.pdf>
- Health and Safety Executive (HSE, 2014) *Health and safety in construction in Great Britain, 2014*. Retrieved on 22-04-15 from <http://www.hse.gov.uk/statistics/industry/construction/construction.pdf>
- International Labour Organisation (ILO) (2009). *World day for safety and health at work 2009: Facts on safety and health at work*, ILO, Geneva. Retrieved on 23-08-15 from http://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/publication/wcms_105146.pdf

- Kheni, N. A., Dainty, A. R. J. and Gibb, A. G. F. (2005) Health and safety management practices of small subcontractors. In: *Khosrowshahi, F (Ed.), 21st Annual ARCOM Conference, 7-9 September 2005, SOAS, University of London. ARCOM, Vol. 1, 105-114.*
- Kheni, N. A., Gibb A. G. F., Andrew, R. J. and Dainty, M (2010) Health and safety within Small- and medium-sized enterprises (SMEs) in developing countries: study of contextual influence. *Journal of Construction Engineering and Management* 135 (10), 1104 – 1115.
- Kronsbein, D., Meiser, D. and Leyer, M. (2014) Conceptualisation of Contextual Factors for Business Process Performance. *Proc.:International MultiConference of Engineers and Computer Scientists, IMECS, 12 - 14 March 2014, Hong Kong, Vol II.*
- Lingard, H. (2013). Occupational health and safety in the construction industry. *Construction Management and Economics*, 31 (6), 505 - 514.
- Manu, P. (2012). *An Investigation into the accident causal influence of construction project features* (Doctoral Thesis University of Wolverhampton). Retrieved from <http://wlv.openrepository.com>
- Mayhew, C. and Quinlan, M. (1997) Subcontracting and occupational health and safety in the residential building industry. *Industrial Relations Journal*, 28 (3), 192-205.
- Ploesser , K., Peleg, M. Soffer, P. Rosemann, M. and Recker, J. (2009). Learning from context to improve business process. *BPTrends* 6(1),1-7.Retrieved on 30-8-15 from <http://eprints.qut.edu.au/>
- Rosemann, M., Recker, J. Flender, C. and Ansell, P. (2006). Understanding Context-Awareness in Business Process Design. *Proc.: 17th Australasian Conference on Info Systems (ACIS) Paper 79.*
- Rosemann, M., Recker, J. and Flender, C. (2007). Contextualisation of business processes. *International Journal of Business Process Integration and Management* 3(1), 47-60.
- Saidani, O. and Nurcan, S. (2007). Towards context aware business process modeling. *Proc.: 8th workshop on Business Process Modeling Development and Support, Trondheim, BPMDS*
- Sgourou, E., Katsakiori, P., Goutsos, S. and Manatakis, Em. (2010). Assessment of selected safety performance evaluation methods in regards to their conceptual, methodological and practical characteristics. *Safety Science*, 48(8), 1019-1025.
- Umeokafor, N. I (2015). An assessment of the influence of contextual environment on health and safety practices in the Nigerian construction industry. In Behm, M and McAleenan (Ed.), *Proc.: CIB W099 International Health and safety Conference, 10– 11 Sept. 2015, Northern Ireland, UK.*
- Vilasini, N., Neitzert, T. R., Rotimi, J. O. B., and Windapo, A. O. (2012). A framework for subcontractor integration in alliance contracts. *International Journal of Construction Supply Chain Management*, 2(1), 17-33
- Windapo, A. O. (2013). Relationship between degree of risk, cost and level of compliance to occupational health and safety regulations in construction. *Construction Economics and Building*, 13(2), 67-82.

RISK MANAGEMENT FOR MULTINATIONAL COLLABORATIONS: APPLICATION ON THE CASE STUDY OF GRAND EGYPTIAN MUSEUM

Khodeir, Laila Mohamed

Department of Architecture, Faculty of Engineering, Ain Shams University, British University in Egypt, Cairo, Egypt

Ahmed, Omar Hesham

Department of Civil and Construction, Faculty of Engineering and Computing, Coventry University, West Midlands, UK

Abstract

Multinational collaboration projects have a very sensitive nature, where specialized teams must be formed and informed of desired tasks in a progressive manner. Mega-construction Buildings in particular - as a nation's landmark - fall under the category of multinational collaborations and are subjected to many complex variables affecting their success. In these projects, leaders of all parties involved must attain a very high level of cross-cultural intelligence, leadership knowledge and skills to face different design challenges that will certainly occur during the process. Recently, new management Philosophies arose to fulfil the gap resulting from the rapid demand and growth of organizational maturity; accordingly, risk management was adopted by most multinational construction firms to maintain a productive streak in the new globalized market. In Egypt, due to the unpredicted risks and lack of efficient leadership knowledge, many firms revoke collaboration investments in order to avoid these risks rather than adapting to the new situations, thus affecting the development of projects of targeted countries. Hence, this research aims to optimize project efficiency by identifying and investigating the root causes of risks facing a major multi-national mega pilot project: *the case of the grand Egyptian museum*, in addition to conducting literature reviews, an interview, and a Delphi panel. The study findings shed light on the key risks affecting the success of multinational mega projects in the Egyptian Construction context.

Keywords: Grand Egyptian Museum, Multinational construction projects, Risk Management

1 Introduction

Risks included in construction projects are either derived from external or internal sources, where external risks normally represent environmental-related risks, while internal risks exist in the project itself. However, these risks are more evident in the Multinational Construction Projects, which incurs more uncertainties. This owes to their large size and the international involvement of different stakeholders, (Zhi, 1995). In Egypt, for example, the fluctuation of economy and governmental policies had a vast impact on the status of implementation of multinational projects, especially after the unstable political circumstances of January 2011, (Khodeir, 2014).

The aim of this paper is thus to identify and investigate the types and root causes of risks embedded in multinational projects, starting from design initiation to design execution. In general, planning a construction project is the most important pillar of a successful project delivery, but, even with a well-planned strategy, errors and failures will arise. One of the most dangerous aspects in a project is the unpredictability and uncertainty of the project's environment. Influential environments can differ from unsuccessful delivery of design plans (design phase) to a sudden crash in market liquidity (construction phase) of some parties involved in the project. Here comes the role of Risk management, which is defined as a systematic way of identifying, analyzing and dealing with risks associated with a project with the aim of achieving the project objectives, (Patrick, 2007).

Multinational construction collaborations in the Middle East and North Africa (MENA) region in general, and Egypt in particular, have increased over the past few years, starting with joint ventures with Arabian Gulf countries, Japanese infrastructure collaboration and Scandinavian countries partnership projects. This imposes risks, such as differences in practices between domestic and foreign partners, policy and financial risks and legal and political risks. In addition to those risks, the inflation rate in Egypt is quite high: 10.2% (2015 CIA.) By the start of the new millennium, global markets became very dependent on political agendas, financial markets and social events. In order to minimize these impacts, project controlling is attained as proper tool that assesses and deals with risks and cultural aspects of these projects in their own environment. Figure (1) shows the number of annual Multinational projects, in Egypt, (MEED, 2014).

2 Introduction to Risk

The word risk was originally coined by the French, and was spelled as "risqué", then it was transferred to England in the 1830's, (Goral, 2007). Risk was primarily defined as a factor of caution, fatality or injury. Later on, the term was adopted by scientific bodies, and has finally been used to indicate uncertainty in projects, (Smith, 2006). The Australian/New Zealand standard on risk management, 2004, offered a more comprehensive definition for risk as "the chance of something happening that will have an impact on objectives; may have a positive or negative impact".

Moreover, Risk is perceived as the probability of unfortunate or unpredictable events occurring in a building project. These events can be predicted prior to occurrence and can be dealt with or managed; accordingly, the term "Risk management" was formed. Risk management is based on the fact that risk should be Identified and classified. A simple, common and systematic approach to risk management, suggested by Berkely (1991), has four distinct stages: risk classification, going through risk identification, risk assessment and suggesting suitable risk response.

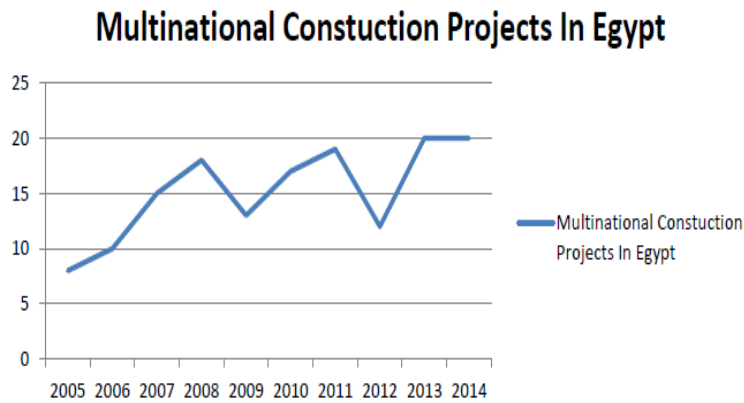


Figure 1. The number of annual multinational projects in Egypt (MEED, 2014)

2.1.1 Identification of Risk

Although the source of risk in multinational construction differs from one project to another, the steps and tools applied for identifying such factors of risk are the same. The first step in the process of risk identification is the risk realization in the building/design process. The next step is the classification of key factors, where root causes of risk are classified. Data concerning the risk identification must be gathered from documentations, expertise or feedback. Identifying risks could be performed by brainstorming sessions, meetings or external notifications, (Goral, 2007). The most widely used and most reliable risk identification tools include using the Delphi technique Interviewing, Root cause analysis, Checklist analysis, diagramming techniques and the SWOT analysis.

The Delphi technique, which is adopted in this paper, is based on a moderator, who is in charge of a session or round. These rounds consist of questionnaires handed to experts (Professional/Academic Experience) (Clarizen, 2013). These questionnaires are then gathered and summarized. Once again, the questionnaires are distributed among the experts for comments. This process can go on for more than several rounds until a solid opinion or model for identified risk factors is delivered at the end of the final session, (DOIS, 2003).

2.1.2 Classification of Risk

This phase of classification of risk factors is dependent on the former phase of risk identification, where gathered and identified risks are classified according to type, severity and impact. The process of risk classification notifies the responsible party whether this risk is affecting the project fulfilment in general or not, (Goral, 2007). According to Zhi (1995), risk factors in multinational construction projects are classified according to economic, political and social change. The most difficult political risks are: war, revolution, civil disorder and inconsistency of government policies, whereas economic and financial risks may arise from a local economic crisis, significant under-development interest rate fluctuations, rising inflation, foreign currency exchange rate fluctuations or raising tax rates. Social environment problems are most likely to be caused by language barriers, religious differences, cultural differences, crime and lack of security, disease, and bribery and corruption.

2.1.3 Risk analysis

This stage involves analysis of identified risks and their impact on upcoming project phases. Risk analysis techniques include both qualitative and quantitative tools. Qualitative risk analysis includes Risk probability and impact assessment (RPIA), the Probability and impact matrix and Risk urgency assessment. The quantitative risk analysis tools, on the other hand, include Data gathering and representation techniques, Probability distributions, Quantitative

risk analysis and modeling techniques, Sensitivity analysis, Expected Monetary Value analysis (EMV), Modeling and simulation, Cost Risk Analysis, Schedule risk analysis and Expert judgment, (Clarizen, 2013; DOIS, 2003).

2.2 Factors Affecting Project Failure

Approaching project failure factors is the best way to identify weak links and risks in a project's process. A survey was carried out by Whittaker (1999) to identify the main factor affecting project success. Questionnaires were given to over 1,450 private and public sectors' construction companies'. The outcome of the study was that unmitigated risks and lack of risk management strategies were the main reason affecting successful implementation of projects. The second and third attributes were lack of skilled labour and deficiency of control. (Whittaker, 1999; Rozene, 2006). Another study was carried out in Jordan by Odeh and Battanieh (2002), to identify the delays in construction companies. The main results found were lack of efficient managerial communication in the construction industry, as well as the high risks concerning contractors' efficiency of constructing the proposed designs (Odeh and Battanieh, 2002; Rozene, 2006).

2.3 Project Success and Risk management

Many researches were conducted in recent years, which were summed up by the project management body of knowledge in 2004. The results indicated Monitoring and controlling risk is an ongoing process in which known and identified risk are kept under supervision, old or outstanding risks are monitored and new risks are treated as soon as they arose (PMBOK, 2004). By adaptation of the previous protocol, any controlled risk in project – if dealt with accordingly – will lead to a successful project. Another research was carried out on 60 mega projects indicated that, by creating a reliable strategic risk management protocol, risk factors are minimized drastically (Florice and Miller, 2001). The study guided by Miller and Lessard (2001) indicated that by establishing a well-designed risk plan, probability of failure due to risk is negligible.

2.4 Risk mitigation deficiencies in MENA

Al-Sabah (2012) conducted a detailed listing of the different risks affecting multinational design and consulting firms in the MENA, with an emphasis on the organizational point of view. The findings of that paper demonstrated the main risks affecting the MENA construction industry regarding internal and external risk factors affecting the efficiency of the project implantation process. One of the most important elements of the research was the increase of cultural risks that affected those projects, ranging from geopolitical uncertainty to conflicts in the design execution. Another sub-topic discussed was the lack of control over the design process risks, weak understanding of the user's needs, communication and cultural conflicts in the design process.

2.5 Risk Mitigation Deficiencies in Egypt

The study by Khodeir (2014) elaborates and examines different risks that affected the overall performance of the Egyptian construction industry over recent years. The paper shed light on the effects influencing the Egyptian market, foreign investment and multinational projects in the construction industry and how they were affected by risks that were not predicted or considered. The paper examined 65 external and internal risk factors that affected Egypt's construction industry between the years 2011 and 2013. The study was based on data collection and risk evaluation techniques. It was conducted on 100 (Local and Multinational) firms in Egypt. The results indicated that among the highest ranked risks (top 20), some were related to design management failures, Communication deficiencies, weak project control and other subsidiary branches of managerial systems that were mostly ineffective. All entities involved

in the construction market were involved and affected by these risks (clients, PMs, engineers and contractors).

3 Methodology:

In order to achieve the objective of this paper, the authors applied three main approaches: literature review of theoretical background, an interview and a survey questionnaire.

3.1 Interview

The interview was held In March 2015 with the former director of the committee for implementation of the Grand Egyptian Museum (GEM) (2009-2012). Table (1) shows the design of the interview questions and their related objectives.

Table 1. Design of the interview

Question	Objective/measured attribute
What were the risks affecting the early stages of the design and design execution?	To attain the maximum amount of knowledge regarding risks affecting the design phase from design initiation to design execution
What were the main risks that were the result of not understanding the Cross-Cultural nature of the project (Design, Contracts, Bidding, Tenders, laws and Conflicts)?	To establish a link between risk affecting design projects in a multinational project scale
What were the problems generated due to the lack of proper risk assessment in the GEM in particular and the Egyptian market in general?	To highlight the deficiencies regarding risk management to form a well-designed risk register
What were the financial risks of the project with regards to funding and contracting?	To understand and measure how the financial risks affect a project of this scale
What were the Owner's risks?	In the GEM case study the owner is a governmental entity, which is a major factor affecting project success
What are the futuristic risks of the entire GEM project?	To ensure a realistic nature of probability regarding the risk register
What are the problems facing the design's constructability?	To highlight design problems directly affecting the constructability of the project

3.2 Delphi Panel

The Delphi panel consisted of 16 participants, including the former director of the committee for implementation of the GEM, along with another three top managers in the GEM project. Two participants were from Hill international; they are current project managers in the GEM project. One project manager was from Orascom Constructions, currently working on the GEM project. The other nine participants included three Project managers from Kuwait, whom were a part of mega and iconic projects in the Middle East and Europe. Three participants were from Canada (Two Architects and an Owner), two from UAE (Project Manager and Architect) and one from the UK (Architect). The seven Delphi participants from Egypt were directly provided with a hard copy of the data, whereas the international participants were provided with the information electronically via E-mail. The Interview notes were presented to the panelist on the first round, the final risk register included 73 Risks. After gathering the first round results and refining them, the Risks were reduced to 67. The new risks were then sent again to the panelists for further editing and commenting. The results were collected for the final time and the comments the participants provided were noted. Finally, a list of 60 Risks was ready for further testing for probability and impact Via Survey questionnaire, Table (2) shows sample participants in the Delphi panel.

3.3 *Survey Questionnaire*

A questionnaire survey was conducted in order to measure both impact and probability of risks that were previously defined through the Delphi panel. A scale was presented for each risk with a numeric range of 1 to 9, where the probability took a range; 1 means that this risk is unlikely to occur and 9 means that the risk will certainly occur. Impact also ranged from 1 to 9, where 1 was given to risks having minimal effect, while 9 was given to risks having the severest impact. A total of 40 participants were requested to fill the survey, all of whom complied. The original Delphi panellists were also among those who conducted the survey. The participants belonged to different countries, genders, ages, expertise and educational background. The detailed information about the participants is indicated in Table (3).

4 **Analysis of Pilot Case Study: The Grand Egyptian Museum, Giza, Egypt (In process)**

The Grand Egyptian Museum Project was inaugurated by the former Egyptian President, Hosni Mubarak, on Feb 4th, 2002. It is Egypt's largest Cultural and iconic Project. It is planned to replace the original Egyptian Museum located in Tahrir square. It is intended to display the World's largest collection of Pharoanic Artifacts representing the evolution and ingenuity of the Ancient Egyptian civilization. The GEM is located at the outskirts of the ancient culture plateau of the Pyramids. It is designed on a gentle slope with a view to the Pyramids as well as a view towards the city of Cairo. The area of the project is about 493,579m² and occupies a total of 181,438 m² in built up area (Barakat, 2010).

4.1 *Description of GEM timeline*

In 2002 the Head of Architecture department of Ain Shams University was assigned by the Ministry of Antiques and Ministry of Culture to form a committee for selecting a design for the newly proposed project of building a new Egyptian museum; a museum that will be a new iconic destination for displaying ancient Egypt's historic eras and artefacts .The idea of creating a new Egyptian museum was extremely welcomed and supported by the UNESCO. A competition was formed later on in 2002 to select the best possible design for the proposed project. A total of 2300 entries were made, 700 of which were then eliminated and 1600 were left. Out of the remaining participants, 20 designs were selected for the final rounds. A jury was formed of the best architects in Egypt and the international architectural community was to select the top 3 designs. The First Prize was the Construction of the design and \$250,000 (Barakat, 2015). In 2003 a preliminary project plan was offered, including the entire project's scope, from schematic design to project completion. A three-phased plan for project design and execution was proposed and an initial budget of 550 Million\$ was projected. Phase I: Project studies; Phase II: Fire station, Conservation centre and Energy Centre; Phase III: Site excavation and project execution. (M.Antiques, 2015).

- **100 million dollars were provided by the** Egyptian government by “The Museums and Archeological Projects Fund”;
- **300 million dollars were provide by** JICA "Japan International Corporation Agency" in the form of a facilitated loan;
- **150 million dollars were obtained from different fund-raising agencies.**

In 2005 the project scope rose from 550 to 800 million dollars. This was due to project scale and complexity, where a number of buildings which were not intended in the original project were added to the project. Additionally, there were complexities in transporting some monuments and antiques to the location of the museum. Funds were collected from various cultural philanthropists, (Barakat, 2015). In 2009 the design documentation was delivered and initial site excavation began. The year 2011 had great impact on the project's performance due

to the unrest in Egypt as a side effect of the revolution that took place, which gradually returned back to normal in 2012. In April, 2015, The Committee announced that further 300 million dollars were required to complete the project, which increased the overall projects' budget to reach 1.1 Billion dollars (Ayad, 2015). Table (4) shows both planned and actual timeline for the GEM.

Table 2. Participants in the DELPHI Panel

Age	Percentage
30-40	18.75%
40-50	37.5%
≥50	43.75%
Total	100%
Country	Percentage
Egypt	37.5%
Kuwait	25%
UAE	12.5%
UK	12.5%
Canada	12.5%
Total	100%
Highest Education	Percentage
Bachelors Degree	37.25%
Masters Degree	37.25%
Doctorate Degree	25%
Total	100%
Field of Experience	Percentage
Architecture/Architectural	37.75%
Engineering (Senior)	31.25%
Project Management (Design and Construction)	31.25%
Top Management (CEO, CFO, COO, etc)	100%
Total	100%
Years of Experience	Percentage
15-25	25%
25-35	43.8%
≥35	31.2
Total	100%

Total: 16 Participants

Table 3. Participants in risk survey

Age	Percentage
30-40	30%
40-50	30%
≥50	40%
Total	100%
Country	Percentage
Egypt	42.5%
Kuwait	22.5%
UAE	12.5%
Canada	10%
UK	7.5%
KSA	5%
Total	100%
Highest Education	Percentage
Bachelors Degree	47.5%
Bachelors Degree	25%
Postgraduate Degree	10%
Masters Degree	17.5
Doctorate Degree	
Total	100%
Field of Experience	Percentage
Architecture/Architectural	37.75%
Engineering	31.25%
Construction/Civil Engineering	31.25%
Project Management (Design and Construction)	
Top Management (CEO, CFO,COO, etc)	100%
Total	100%
Years of Experience	Percentage
15-20	12.5%
20-25	35%
25-35	27.5%
≥35	25%
Total	100%

Total: 40 Participants - 40 / 40 Respondents

Table 4. A brief of GEM phase completion (Actual and planned)

Year	Planned Phase Completion	(Planned) % Completed	Actual Phase Completion	(Real) % Completed
2002	Design selection	10	Design selection	10
2003	Design Preparation	20	Design Preparation	20
2004	Design Preparation	30	Design Preparation	20
2005	Design Delivery	35	Design Preparation	20
2006	Site Excavation	40	Design Preparation	20
2007	Site Excavation	50	Design Preparation	20
2008	Construction Initiation	60	Design Preparation	20
2009	Construction Progress	70	Design Preparation	30
2010	Construction Progress	80	Design Delivery	40
2011	Construction Progress	90	Site Excavation	45
2012	Project Completion	100	Site Excavation	50
2013		100	Construction Initiation	60
2014		100	Construction Progress	70
2015	New extension in project completion	100	Construction Progress	80
2016		100	Construction Progress	90
2017	New extension for project completion	100	Construction Progress	95
2018		100	Project Completion (Estimated)	100

5 Findings

Findings presented in this section are extracted from the interview. The Risk register developed using the Delphi panel and the findings of the survey questionnaire. Findings of the interview formed a base for the Delphi panel that was applied later on. These findings were carefully analyzed in order to create a well-structured risk register. The initial register included 78 risks, whereas the final refined register after applying the Delphi panel included 60 risks. The Final Risk register, shown in table (5), identifies the 60 main risks that emerged in the case study project according to both the interview and the Delphi panel. The table offers description of each type of identified risk, the nature of its impact, either positive or negative, and its root cause. A coding system is suggested for the Classification of the risks, in order to facilitate the understanding of root causes of risk and help establishing a relevant mitigation approach. The classification was based on two main factors:

- The source of Risk/emerging phase: Design=D, Executive=E, Legislative=L, Governmental=G, Socio-Political=SP
- The impact of Risk/ Influence on involved parties or phases: Consultants and Contractors=C, Owner=O, Design Execution=DX

The risk register was passed afterwards to the respondents of the questionnaire survey to measure the exact Expected Monetary Value (EMV) of each detected type of risk. In this section, the findings of the questionnaire survey were presented. These included the probability and impact results of each type of the top-identified risks. Results were displayed in terms of Mean, Median and mode ranking. Figure (2) and figure (3) respectively represent the

probability and impact results of each top-identified risk. Table (6) presents the final expected monetary value EMV, which represents the total outcome of the risk, whether it has a positive or negative impact depending on the situation. The table arranged risks from highest risk to lower risks, driven by the results received from applying the EMV equation in Risk.

(EMV): Risk = Probability × Impact.

5.1 Highly Ranked Risks

Upon observing the highly ranked risks and remarking risk nature, it appears that legislative risks in general were considered to be a major setback in multinational collaborations, according to the survey participants. They were also drastically affecting the GEM project. Table (6) highlights the top-ranked risks. Table (7) shows the top root causes of risk according to analysis and their related phases of the project. It emphasizes the fact that most top risks are related to decisions made in the design phase.

Table 5. Sample of the Risk Register

#	Code	Risk Description	Nature of impact	Root Causes
1	D-1-DX	Design Selection	Positive	UNESCO-sponsored Competitions for GEM Design Selection
2	D-2-DX	International Expertise in Design and Execution	Positive	Joint Funding Venture (Egypt, Japan) Multinational Collaboration (Egypt, Japan, UK, Ireland, Belgium, US)
3	L-1-O	Failure to sign with desired design firm	Negative	Law 89-1998 For Bids and tenders does not consider design competitions as a legit bid or tender which is the only allowed form of contracting (Government contract)
4	L-2-O	Law restrictions	Negative	
5	D-3-O	Law restrictions affect design quality.	Negative	Law 1998-98 For Bids and tenders -Article 16- two committees are formed (Technical and Financial) to study offers in both criteria and the preferable selection is mainly to the lower cost
6	L-3-O	Direct Order (Ministry Funding)	Positive	Law 89-1998 For Bids and tenders - Article 7 - Senior State officials are entitled a direct order of a (limited) governmental fund spending in critical situations.
7	E-1-C	Lack of complex project management knowledge	Negative	Former directors (Early Design stage) lacked proper project management skills.
8	D-4-DX	Lack of Client experience in complex Design projects	Negative	Due to the fear of failure, social and political pressure, the Minister of Culture broke down the design contract into 4 phases which resulted in 2.5x increase in design cost
9	SP-1-DX	Design Contract Break Down	Negative	Competition won in 2002, Design Delivered 2009 (8 years), delivery scheduled (3-4 Years)
10	G-1-DX	Design delivery delay due to misconduct in contracting	Negative	Delay In design Delivery means delay in Construction initiation (Penalty Clause is applicable) Must be paid by client to Assigned firms.

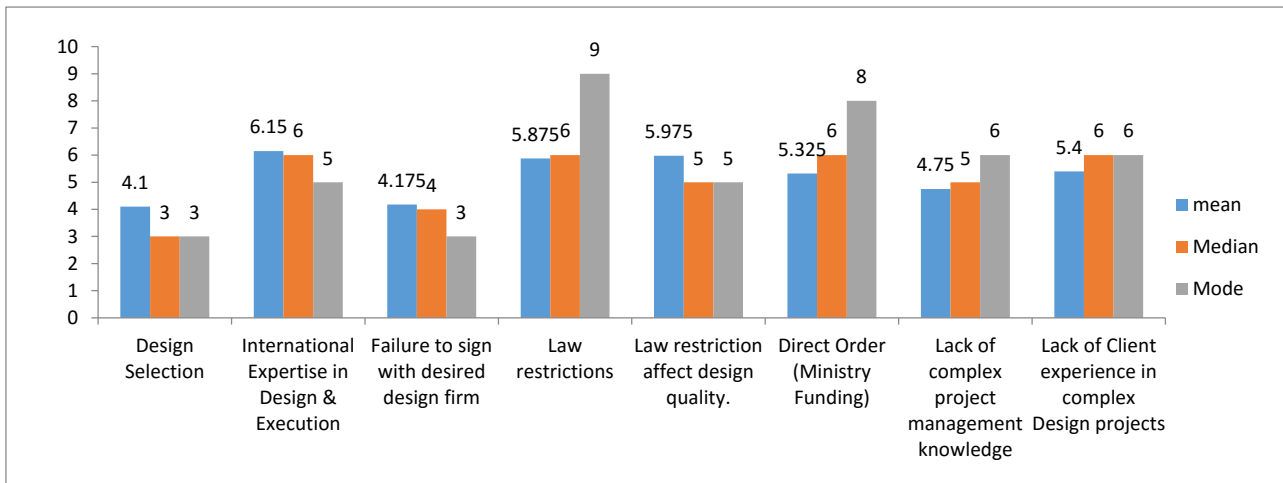


Figure 2. Findings of Risk Probability

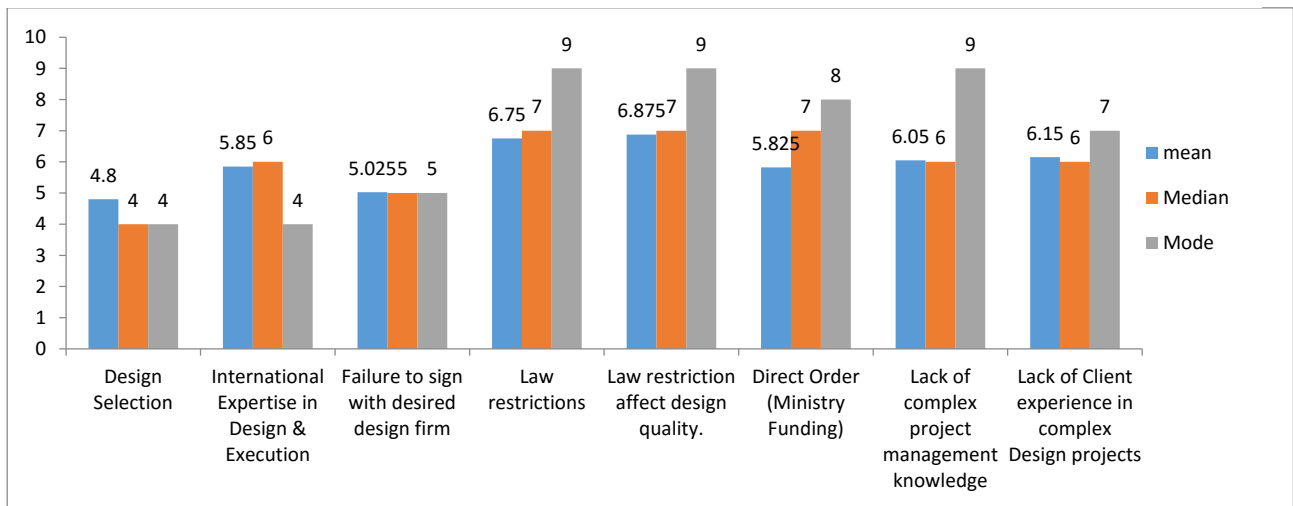


Figure 3. Findings of Risk Impact

Table 6. Top-ranked risks

Rank	Code	Risk	Risk Nature	Effect	T Variance	Total SD	EMV
1	L-5-DX	Egyptian law does not recognize the project management profession (Government Contracts)	Legislative	Negative	3.438639063	0.085966	0.61992284
2	D-3-O	Law restrictions affect design quality	Design	Negative	7.316951563	0.182924	0.507137346
3	L-2-O	Law restrictions	Legislative	Negative	8.206826563	0.205171	0.489583333

Table 7. Top causes and phases of emergence of risk

Source of risk /emerging phase	Impact of risk	Description	EMV
Design	D-3 O	Law restrictions affect design quality.	0.507137
Executive	E-18 O	Unplanned mitigation actions (Management)	0.446142
Governmental	G-10 O	Mistrust (Bidders)	0.425995
Legislative	L-5 DX	Egyptian law does not recognize the project management profession (Government Contracts)	0.619923

5.2 Risk Perception

In this section, a comparison is made among the top 10 risks, according to the perception of Egyptian participants and the international participants. This will allow for a comprehensive understanding of the different points of view. Moreover, this will ease the process of extracting similarities and differences in types of risks affecting both the local and the international construction market, Table (8), where it is clear that the top three risks according to both international and National perceptions are restrictive laws and policies which affect design quality and, in turn, banish experts in management disciplines in the construction market. Both local and international communities are suffering from currency fluctuation.

Table 8. Top national/international risks in Multinational Projects

INTERNATIONAL EMV			EGYPT EMV	
#	RISK	EMV	RISK	EMV
1	Egyptian law does not recognize the project management profession (Government Contracts)	0.639781	Egyptian law does not recognize the project management profession (Government Contracts)	0.607289
2	Law restrictions affect design quality.	0.512757	Law restrictions affect design quality.	0.503704
3	Law restrictions (Egypt)	0.469081	Law restrictions (Egypt)	0.501412
4	International Expertise in Design and Execution	0.433251	Involvement of military contracting	0.480632
5	Unplanned mitigation actions (Management)	0.405322	Design Contract Break Down	0.47759
6	Mistrust (Bidders)	0.396433	Lack of Client experience in complex Design projects	0.475457
7	Limiting exposure to international innovations (Design and Construction)	0.39177	Unprofessionalism (Client)	0.474252
8	Increasing efficiency by increasing monetary reward (Client)	0.39177	Unplanned mitigation actions (Management)	0.471467
9	Involvement of military contracting	0.387106	Opportunity for corruption	0.461906
10	Currency Fluctuation	0.377778	Currency Fluctuation	0.459378

6 Conclusions

This paper sheds light on the inefficiency of planning, monitoring and controlling processes of risks that deal with the different aspects of cultural variances in the present construction industry. This in turn affects the work flow communication among involved parties due to lack of proper preparation and management in different categories.

Upon viewing the current practices of risk management and examining the failures of delivering successfully planned project in the modern construction industry in the MENA region, it is clear that these factors affect the planning, controlling and implanting of successful construction projects. These projects are influenced by a diverse spectrum of risks. These risks are mainly the result of two main deficiencies: lack of adequate cultural knowledge and poor prediction and planning of process risks. Regarding the Egyptian context and the top occurring risks in Multinational projects, findings of this paper show that a number of corrective actions should be adopted, including:

- Review and modification of law 89-1998, which represents a major setback for future Multinational collaborative projects, as it limits the competitiveness of quality and emphasis of quantity.
- Multinational collaborative projects buildings need special consideration in terms of bidding and tendering as the selection process should be based mainly on quality of provided work.
- Project management profession must be acknowledged by the Egyptian law: their roles and responsibilities should be set by the policy makers in order to avoid any conflict with the law.
- The construction industry in Egypt needs robust supervision to eliminate abuse of power and position.
- Flexibility when assigning International ventures to benefit the country both financially and knowledge-wise.

7 References

- AS/NZS 4360 (2004). Australian/New Zealand standard on risk management. Standards, Australia and Standards, New Zealand.
- Al-Sabah, R. (2012). Evaluating Significant Risks in the Middle East North Africa (MENA) construction projects from perspective of Multinational firms, University of Wisconsin, Madison, Wisconsin, USA - PHD, pp. 1-10.
- Ayad, M. (2015). 300m needed to complete Grand Egyptian Museum: Antiquities Ministry. Daily News Egypt , <http://www.dailynewsegypt.com/2015/04/26/300m-needed-to-complete-grand-egyptian-museum-antiquities-ministry/>.
- Barakat, E. (2015). Former Manager of GEM, Interview, Cairo, Egypt.
- Barakat, E. (2010). Ministry of Culture-The Grand Egyptian Museum -Project Implementation Report.
- Berkeley, D., Humphreys, P.C. and Thomas, R.D. (1991). Project risk action management' *Construction Management and Economics*, 9 (1) 3-1.
- Clarizen. (2013), Risk Management, Useful Tools and Techniques.
- Department of Defence (DOD) (2011). Work Breakdown Structures for Defense Materiel Items, Revision C.
- DOIS. (2003). Methodology report. section 5.
- Fact Book by CIA (2015). Egypt economy section website:

- <https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html>- last accessed 12-4-2015.
- Florice, S. and Miller (2001). Strategizing for anticipated risks and turbulence in large-scale engineering projects. . *International Journal of Project Management* , 19(8), pp. 445–455.
- Goral, J. (2007). Risk Management in the Conceptual Design Phase of Building Projects. CHAMBERS University Structural engineering journal , pp.17-35.
- Zhi, H. (1995), Risk management for overseas construction projects, *International Journal of Project Management*. Vol. 13, No. 4, pp. 231-237.
- Khodeir, L. M., and Mohamed, A. H. (2014). Identifying the latest risk probabilities affecting construction projects in Egypt - political and economical variables 2011-2013.
- MEED (2014). Middle East Business Intelligence, after International Monetary Fund, World Economic Outlook Database, <http://www.meed.com/middle-east-economic-data/3099729.article#Egypt>, last accessed 15/11/2015.
- Ministry of Antiques (2015). The Grand Egypt Museum Website. <http://www.gem.gov.eg/>.last accessed 1/11/2015.
- Miller and Lessard. (2001). Understanding and managing risk in large engineering projects. *International Journal of Project Management* , 19 (8), pp. 437–443.
- Odeh., A. M. and Battaineh, H. T. (2002). Causes of construction failures: Traditional Contracts. *International Journal Of Project Management*, pp. 67-73.
- Patrick X.W., Zou, G.Z. and Wang, J., (2007). Understanding the key risks in construction projects in China - *International Journal of Project Management*. 25, 601– 614.
- PMBOK. (2004). Project Management Body of Knowledge, PMI, PM journals 2004, 5th Ed.
- Rozenes, S., Vinter, G. and Spragget, S. (2006). Project Control: A literature Review. pp. 1-11.
- Smith N.J. et al (2006). *Managing Risk in Construction Projects*. Blackwell publishing. 2nd Ed.
- Whittaker, B. (1999). Unsuccessful projects. *Information Management and Security*. 7 (1), pp. 23–29.

TRENDS IN CULTURAL AND SOCIETAL MANAGEMENT OF CEMENT MURAL IN GHANA

Micah, Victor Kweku Bondzie; Donkor, Evans Kwadwo

Department of Sculpture, School of Applied Arts, Takoradi Polytechnic, Takoradi, Western Region, Ghana

Abstract

Cement mural over the years has trend with humanity internationally and has played matchless role in cultural and societal management in the definition of Ghanaian culture and traditions. It is an effective instrument for Ghanaian cultural meanings and interpretations based on philosophies, themes, concepts and its social significance of promoting one's self-esteem. This study, therefore, seeks to examine the trends in cultural and social magnitude of cement mural and analysed its traditional connotations based on Ghanaian beliefs and lifestyles. Descriptive research design, using case study was adopted at examining and analysing the trend of cultural and societal significances of cement murals in the Ghanaian tradition. The researchers tend to validate the trending nature of cement mural in these two realms of management on repercussions of its value. Based on the research approach adopted, it was deduced that murals express various traditional, cultural and social meanings that relates to the history, beliefs and personal philosophies of Ghanaian people. As trending, the aesthetic appreciation of cement mural is grounded on individual cultural and societal influences as it is mostly seen on walls, facades and columns of modern architectural edifice and houses in Ghanaian communities. The study concluded that murals tend to draw art lovers to the facility, beautify the structures and make the structures more of traditional or give it an African touch. Implication of findings drawn on individual's dictum revealed that cement murals done on individual homes or houses bring out the true persona of individual uniqueness and also create an undying bond between cultural and societal management as based on aesthetics.

Keywords: Cement mural, Ghanaian, Culture, Architecture

1 Introduction

Cement mural has been aesthetically used for many roles in the development of humanity from time immemorial. Looking at Qi's functions of modern mural art, Murals not only serve as "decoration" for beautifying people's living environment but also have especial social and cultural properties that meet aesthetic needs of the public and possess functions for reflecting the ethnic, folk, and contemporary culture trend as well as functions for socio-cultural welfare purpose. Artistic creation murals in harmony with environment can enhance the art value, cultural value of environment and add its functions. Murals of new era can also reproduce historical events, heroic deeds of historical figures, thus playing a role in narration. As people's living standards have been improved and aesthetic demands have increased, murals begin to enter small space such as private houses and therefore decorative functions of murals, decorative functions of murals become increasingly obvious (Qi, 2014).

In Ghanaian cultural setting, in order to appreciate these impacts of cement mural on architectural buildings, some basic factual elements on both cultural beliefs and major artistic lifestyles are necessary. The artistic lifestyles or qualities in these cement mural affirm that shared aesthetic conscience exists across cultural beliefs, expressed in distinctive and precise form, and that it can be jointly perceived by the creator as well as the perceptive observer. This cement mural is a metaphor for the African Ghanaian cosmology that dramatically harmonizes humanity and the environment, integrating individuals and art into larger structures of family, clan, communal groups, and tribal identity. Cement mural in Ghana is a truly diverse experience of the pleasing aesthetic creations that acknowledges the artistic impulse existed between mankind and his environment. It touches a range of human emotions, some subtle, some overt. Anthropological facts on mural may help every individual to understand the skills and may enhance the appreciation, but ultimately the aesthetic response rests upon the art form presence. Understanding this form of art means to stand the cultural and social significance before it and perceive it closely, being receptive to the emotions it generates.

The ecstasy in Ghanaian cement mural speak to its viewers, this is agreed on Evergreene (2015) statement as shared that “Cement murals – especially those in prominent and public buildings – are designed to interact with the viewer and the space in which they are placed. They often tell a bigger story; a story about a specific time, a specific place, and specific people.” However without a doubt, murals have been around as long as people, as a form of valuable testimony of life from the prehistoric time to today. From the cave paintings at Lascaux Grottoes in southern France to the street art murals of today, people have been leaving signs of their own existence in many places around the world. It is because of the earliest scratching, carvings, etchings and paintings that we now have priceless knowledge of our history and predecessors, and these murals hold great significance for mankind, as they depicted life activities, everyday scenery and usually religious traditions of the time they were created in, giving us a priceless look of the diversity of our cultures during different periods. Over the course of time, murals have covered the interiors and exteriors of many public buildings, such as palaces, temples, tombs, museums, libraries, churches and the houses of rich art patrons, spreading onto the streets and architectural elements more recently, all the while keeping their initial meaning and purpose: to paint a picture of society, created from stories, values, dreams, change (Kordic: 2015).

The Ghanaian cement mural sculpture in its finest representations can be culturally and socially examined aesthetically in terms of form, composition, and presence. Again the art works in this rendition possess these characteristics, often in boldly innovative designs or geometric patterns incorporated with Adinkra symbols. Cement murals especially those in prominent individual and public buildings are designed to interact with the viewer and the space in which they are placed. They often tell a bigger story; a story about a specific time, a specific place, and specific people. The cultural and societal of creating cement murals on walls, facades, columns are considered by sculptors to be an integral part of building. As cement murals cover quite large surfaces that could be of different texture, constitution and attributes artists have developed several techniques adaptive to wall surfaces. One of these is plastering, which uses cement or mortar on walls or ceilings. In many cases the sculptural wall is also structural - supporting the rest of the building. Though these cement forms of murals are very trendy in Ghanaian culture, very little is written on the cultural and societal significances these cement murals possessed. The research thus intends to make available answers to the inadequacies as well as strengthen the cultural and societal management of cement murals in the Ghanaian setting.

2 Literature Review

Kordic (2015) again shares that the word mural originates from the Latin word “murus”, meaning “wall”. Today, we can define murals as any piece of artwork painted or applied

directly onto a wall, ceiling or other larger permanent surfaces, flat, concave or convex, to be precise. A favourite technique of many artists, including masters like Leonardo Da Vinci and Michelangelo Buonarroti, the art of muralism flourished during the 1920s, after the Mexican revolution. It is during this time that murals got a new dimension as a powerful visual communication tool, meant to promote the opinion of the people and to transmit social and political messages towards unity. Through the large paintings of “the great three”: Diego Rivera, José Clemente Orozco and David Alfaro Siqueiros, murals became the most important form of expression, often the subject of controversy and always a symbol of solidarity, freedom and hope. The Mexican muralism art inspired the creation of many other similar movements around the world, the biggest being the Chicago art movement in the 1960s. Murals also represent one of the most important features of Northern Ireland, depicting the region’s past and present political and religious divisions. Since the 1970s, the country has seen almost 2,000 paintings dedicated to the fight against racism and environmentalism, among many other issues. Another famous place charged with political murals was the Berlin Wall, whose Western side saw many murals between its creation in 1961 and its destruction in 1989, including the works by artists Keith Haring and Thierry Noir. Staying true to their role of expressing religious and political beliefs within societies, murals represent a mighty tool of emancipation, freedom of expression and social activism and propaganda. Today, in many places around the world and mostly in South America, mural art is used to speak in the name of and depict communities, nations and cultures. At the same time, murals represent an aesthetic element which helps them integrate into their environments and turns them into true cultural artefacts and even monumental works. Apart from their well-defined meanings, murals are also created with other purposes, such as advertising or simply for the sake of a beautiful image on a wall. With street art becoming more mainstream, many big brands often collaborate with mural artists in creating promotional campaigns and designs, and many world-famous street art and graffiti artists successfully paint their murals everywhere, showing incredible skills and talent which formed their own highly distinctive artistic styles.

Jonsson (2015) is of the view that there have been murals on walls throughout the world for as long as there have been people on Earth. People scratched them, carved them, etched them and painted them. The history of murals and mural painting is rich and varied, from the prehistoric cave paintings at Lascaux, France, to the celebratory and ceremonial murals of ancient Egypt, Rome, Mesopotamia, Greece and India. According to art historians, mural painting dates back at least 30,000 years to cave paintings. (Other historians credit the Minoans and the Etruscans.) Some of these impressive works have been preserved, thankfully, by the very caves which they inhabit. These ancient murals typically depict the activities of a particular civilization’s people, encapsulating a moment in time, and range from scenes of hunting, gathering, and family life, to religious and funerary scenes. An interesting evolution continues in the world of murals. New ones are continually being commissioned and created while old ones are constantly being rediscovered and restored (i.e. ca. 100 AD Mayan wall paintings at the remote ruins of El Petén and San Bartolo in Guatemala, which were discovered fairly recently in March 2001). The purpose of murals varies from culture to culture, and from time period to time period. Several examples follow. Many murals in the Tibetan world, both ancient and contemporary, are created as part of meditative and reflective Buddhist practices. During the Baroque period in France, Germany and England, rich art patrons and royalty had Biblical and allegorical murals painted on the ceilings and of their luxurious homes and palaces. Patrons often had themselves painted into the mural, as a way of capturing their likenesses for all time. Mural art appears on the walls and ceilings of interior and exterior spaces, ranging from palaces, temples, and tombs, to museums, libraries, churches, and other public buildings. In our more contemporary era, murals have found their way onto a large variety of surfaces. An important point to finish this section with: Good mural artists will consider their mural in

relation to the mural's natural or architectural setting, allowing the piece to become an aesthetic, social, and most importantly, cultural, artefact. Worth noting...Murals date to Upper Paleolithic times, such as the paintings in the Chevaux Cave in Ardeche (southern France) around 30.000 BC. Ancient murals have also survived in Egyptian tombs circa 3150 BC, the Minoan palaces from the Neopalatial period circa 1700-1600 BC, and in Pompeii circa 100 BC to 79 CE (AD). These ancient murals were 'painted' with whatever materials, always natural, were available at the time.

Cultural and societal connotations conveyed by cement murals are beneficial to enhancing human mental minds and achieving dual functions of appreciation of aesthetic beauty and enlightenment, truly reflecting social value of cement mural. Diverse space environment and extensive aesthetic collections increase the demand for murals, and especially the increase in large public buildings provides greater prospects for mural development, and meanwhile brings more limiting factors for mural creation as well as imposing more requirements for selecting themes, expressing vectors of inner spirit. Therefore, the viewers' aesthetic ability and aesthetic taste should be taken into account during considering the diversity of space buildings. Murals can adapt to requirements for space functions and forms of specific environment, thereby achieving its own aesthetic perfection, so that people can enjoy the environment aesthetically and get spiritual enjoyment fully. At the same time they can achieve social functions of indoctrinating and promoting human relations, which can be best shown from the square in this respect, as the square buildings as micro-environment are more open and broader, who's various groups of appreciation have different levels of aesthetic standards and rich aesthetic tastes. It is important to reflect the openness and characteristic civilization of regional cities in medium environment (Qi, 2015).

Lau (2015) cites that many of the murals of Mohammad Mahmoud Street near Tahrir Square, created to commemorate the martyrs of the 2011 Revolution, can be observed to make remarkable use of symbols and motifs of ancient Egyptian art. At the same time, the continuing protests in Egypt have largely been divorced in Western academic discourse from any discussion of ancient Egyptian history. This pattern of disassociating modern Egypt from its ancient past has been prominent in Western thinking ever since colonizers first began to collect ancient Egyptian artefacts and documents in their own private institutions. When one of these institutions, the Institute d'Egypte, burned down in December 2011 together with many of its important historical documents, some in the West began asking questions about the Egyptians' irreverence toward their own history. In fact, however, history as cultural and social memory could not be more alive in the Egyptian Revolution and its aftermath. The Revolution has reinvigorated history on the street in a way that has the capacity to produce change in society. The most tangible evidence of this is in the street murals of Mohammad Mahmoud Street, which incorporate Egyptian art in a way that endows both ancient and modern history with new meanings and that invites participation from the street, empowering Egyptians on both the individual and societal level, and legitimizing the presence of the people at a time when the state has oppressed their very existence.

Cultural pride serves as a cornerstone of culturally competent social work practice. Cultural competence, in turn, also relies on a strengths perspective toward individuals and communities (Delgado and Barton, 1998).

Looking at these assertions from various authors as cited this literature, all the views are geared towards the cultural and societal impact murals have on the individuals and the community as well.

3 Research Methodology

Descriptive research design, using case study which allows examining and analysing the trend of cultural and societal significances of cement murals in the Ghanaian tradition was used. Case study research conducted for this study involved an in-depth study of individuals who owned private buildings and social business centres with cement murals. Case studies often lead to testable hypotheses and allow one to study rare phenomena. Case studies should not be used to determine cause and effect, and they have limited use for making accurate predictions (Halle, 2011).

The choosing of sample size depends on non-statistical considerations and statistical considerations. The non-statistical considerations may include availability of resources, manpower, budget, ethics and sampling frame. The statistical considerations will include the desired precision of the estimate of prevalence and the expected prevalence of eye problems in school children (Explorable.com, 2015).

On the other hand, the sample size obviously depends on the type of research. (Dawson, 2002). The research sample size of 50 respondents were contacted for this sampling procedure. These 50 respondents were comprised of five building industries as they were purposively selected for the research population. These were Akroma Plaza, Brown's resident, Frebe Mall, Naakoff Chinese Hotel & Restaurant both Takoradi and Adjei-Boye's Villa located at Dawhueya, Tema. Specifically, these five buildings were chosen for the study, based on the criteria that they contained the trendy nature of cultural and societal management pertaining cement murals done contemporary to suit the architectural edifice. Research was conducted by purposive sampling technique for the study. The sample is made up of 15 workers of Akroma Plaza, 5 workers of Brown's resident, 15 workers of Frebe Mall, 10 workers of Naakoff Chinese Hotel & Restaurant and 5 individuals of Adjei-Boye's villa.

A form of non-probability sampling in which decisions concerning the individuals to be included in the sample are taken by the researcher, based upon a variety of criteria which may include specialist knowledge of the research issue, or capacity and willingness to participate in the research. Some types of research design necessitate researchers taking a decision about the individual participants who would be most likely to contribute appropriate data, both in terms of relevance and depth. For example, in life history research, some potential participants may be willing to be interviewed, but may not be able to provide sufficiently rich data (Oliver; 2013).

In this fact, this purposive sampling as a feature of qualitative research, researchers handpick the buildings have cements murals on the basis of their judgement of their typicality or possession of the particular characteristics being sought. In this way, they build up a sample that is satisfactory to their specific needs. (Cohen et al., 2010).

Data collection tools were semi-structured interview, participant observation, focus group on discussions of personal viewpoints. Participant observation helped the researchers in some history, uses and purposes of cement mural done in Ghana. All collected data was validated using a triangulation method and analysed by analytic induction and typological analysis. The results are here presented as a descriptive analysis.

"Careful planning for data collection can help with setting realistic goals. Data collection instrumentation, such as surveys, physiologic measures (blood pressure or temperature), or interview guides, must be identified and described. Using previously validated collection instruments can save time and increase the study's credibility. Once the data collection procedure has been determined, a time line for completion should be established." (Pierce, 2009:159).

4 Findings and Discussion

The beauty of Ghanaian cultural and societal trends takes the standpoint of an understanding of contemporary Ghanaian society and culture that requires a good understanding of traditional institutions, beliefs and practices. This study therefore further goes on with aesthetic appreciations of cement mural works imbued with Ghanaian traditional culture, social organization, social institutions and world-view before tackling the influence of contemporary cultural and social changes on cement mural. Some important factors of change to be considered include: colonialism, Christianity, formal classroom education and monetization of the economy. Other features of modernization to be treated are urbanization, industrialization, migration (rural-urban), globalization and new and increasing advances in communication technology (Nukunya, 2003).

All these influences have taken roots in the Ghanaian arts and culture. Cement mural in places talks more about ones ideology, philosophy of cultural and social affirmation of life. These trend in cultural and societal management are a fundamental skill required of professional artists especially sculptors and in many other fields of art. In modern cement mural practice, an ability to create images and to encode them with meaning is central to the creative process. With an emphasis on design practice and analysis, this art form aims to develop ones understanding of the fundamentals of visual language and design principles. These visual languages and design principles come in a form of geometric patterns, shapes, lines and dots. This provides the public or viewers with a core knowledge base from which one can build visual problem-solving skills and enhance one's ability to plan, create and critically evaluate one's own image-making processes.

Looking at these visual languages and design principles that come in a form of geometric patterns, shapes, lines and dots. They have been used to form compositions that speaks and promotes Ghanaian tradition. Below are some aesthetic appreciations of cement murals in various forms of composition on buildings especially walls, facades and columns:

Appreciation 1: In Akan language "Ahyiabia" explains the etymology of the hotel, bar and restaurant name, "Akroma Plaza" as the meeting place. Akroma Plaza started operations in 2002 with the restaurant and catering business as its core business. With the motto "Attaining Heights in taste". Akroma Plaza climbed high in hospitality ladder to attain the status of the best restaurant of the Western region in the grade one category. With a high demand for conference facility and accommodation, Charlie Hall, the hotel and auditorium were added to the existing facilities. Rightly coined, "A world of comfort in the heart of town", there is no holding back on quality when it comes to Akroma Plaza. The composition of cement mural on the façades and pillars of the hotel brings the act or process of converging and the tendency to meet in one point. The work has representation of all human forms coming together under one roof. That is the point of convergence or meeting place within the work. The interplay of these element gradually bring the unfolding calescence. The meeting place symbolizes the coming together of different people in the contexts of harmony, joy, happiness, peace and relaxation under a comfort serene environment or atmosphere (below shows figure 1a and figure 1b - The meeting place).



Figure 1a. The Meeting place



Figure 1b. The Meeting place

Appreciation 2: Progression among humanity involves important ideas that are neither trivial nor obvious, these ideas need to be taught in ways that are interesting and engaging to mankind. The totality of concepts involved in this work of art means the gradual movement and development of human activities towards a destination of succession. This describes concepts and representations of relationship between man his creator, ancestors, deities and lesser spirits. In Ghanaian culture, an adage goes like “Enam dua so nti na ahuma hunu esoro” literally means one becomes successful through his fellowman’s help. Therefore this long stretched chain composition of distorted human figures seeks to reiterate the value of togetherness and the qualities jointly compose and execute by mankind to attain victory through endurance. Progression is a long stretched chain wall mural composition that has human figures arranged up and downwards, twisted and jointly executed together. The composition reveals various form poses of human figures in geometrical objects.

These forms poses are embedded with geometric lines, dots, patterns and shapes which symbolize a comprehensive and representative state of humanity trying to be successful and help themselves to accomplish their ambitions (see Figure 2: Progression).



Figure 2. The Progression

Appreciation 3: Sankofa symbol appears frequently in traditional Akan art, and has also been adopted as an important symbol in an African American and African Diaspora context to represent the need to reflect on the past to build a successful future. It is one of the most widely dispersed Adinkra symbols, appearing in modern jewellery, tattoos and clothing. This work dialogues to its viewer the philosophical ideas and symbols of taking from the past what is good and bringing it into the present in order to make positive progress through the benevolent use of knowledge. The work is coupled with round objects, bigger dots and smaller ones which seeks to provide enlightenment of Ghanaian culture through educational, cultural, and social events and activities. The lines on the wings symbolizes the Akan people's quest for knowledge among the Akan with the implication that the quest is based on critical examination and intelligent and patient investigation. Thus the Akan belief that the past serves as a guide for planning the future. To the Akan it is this wisdom in learning from the past which ensures a strong future. The Akans believe that there must be movement and new learning as time passes, but as this forward march proceeds the knowledge of the past and must never be forgotten. Sankofa in Akan language literally and culturally means going back to fetch it, that is "se wo were fi na wo san kofa a yenkyi" (it is not a taboo to go back and retrieve if you forget). This symbol of made of cement on a wall proposes wisdom in learning from the past in building the future. The work is composed of a bird that has it head turned backwards with an egg in its beak touching the back. The work teaches us that we must go back to our roots in order to move forward. Visually and symbolically "Sankofa" is expressed as a mythic bird that flies forward while looking backward with an egg (symbolizing the future) in its mouth (see Figure 3: Sankofa).



Figure 3. Sankofa

Cement mural has been aesthetically used for many roles in the development of humanity from time immemorial, when people sculpted and painted depictions of their beliefs. Presently, people have begun to adorn private and commercial or religious structures with cement murals depicting lifestyle and religion and philosophical themes are incorporated.

The findings of the research study clearly revealed that cement murals in private or public places of building evolved generally as a solution to the cultural and societal needs of the individual and people of the community. In making this type of art form, cement is mixed with sieved sand or fine stone dust together with water as materials whereby they were used in the construction of cement murals. This does not only present readily available materials for practicing the above art form, but also made it possible for the aesthetics complement of the place. The cement murals clearly revealed the cultural and social thoughts and characteristics of the individually own buildings. This is in significant agreement with the research of Heather (2009), which investigated the 2500-year-old murals of the Mayan people of Guatemala. Hurst concluded that the creative process, content, style and materials had been adapted in line with technological advancements, social evolution and generational politics. There were clear periods of Mayan murals, such as pre-classic and classic. Cement murals found on these buildings thematically summarized the philosophical and cultural propensity of the buildings. Sculptors and building owners played an integral part in cement mural rendition, which clearly showcased their beliefs, concerns, interests, and aspirations. This lends credence to the findings of Wemegah (2013), who brought out the intricacies of mural decorations in the Sirigu Culture., since it served as a beautification of satisfying aesthetics and evidently showcasing the philosophical and cultural themes of the people.

It was also factual from the research findings that the role of the cement murals on buildings goes beyond adornment of the buildings. This is demonstrated on buildings where cement murals executions are highly propounded and displays the aesthetic values on the general spatial environment. Cement murals therefore, in this perspective, cannot be said to be only limited to the aesthetics, but also helps in cultural and societal therapeutic values on buildings. Buildings or houses with such edifices, are important instrument used in imparting our traditional values not only aesthetics but providing the cultural and social importance to the individual and the community as a whole.

5 Conclusion and Further Research

Based on the findings of the study, it therefore allowed to conclude that cement murals on buildings or houses in private or public places are not done artistically and aesthetically please the individual and the community but based on its cultural and societal connotations. This artistic rendition embodied great percentages of the cultural and social values based on personal philosophies of the people. The research obviously showed that materials used in the execution of cement murals were naturally materials with the exception of cement which is chemically oriented but environmentally friendly when it comes to working with it.

6 References

- Dawson, D. C. (2002). *Practical Research Methods*. Oxford: How to Books, Ltd.
- Delgado, M. & Barton, K. (1998). *Murals in Latino communities: Social indicators of community*. National Association of Social Workers, Incorporated, pp 5 & 6.
- Evergreene. (2013, August 30). Evergreene Architectural Arts. Retrieved from WPA Murals: The Cultural Importance of Preserving Artwork in Architectural Settings: <http://evergreene.com>
- Explorable. (2015, August 26). Sample size. Retrieved from Explorable: <http://explorable.com>
- Halle, J. (2011, September 27). The 3 Basic Types of Descriptive Research Methods. Retrieved from Psychcentral: <http://psychcentral.com>
- Heather, H. (2009). *Murals and the ancient Maya artist: A study of art production in the Guatemalan lowlands*. New Haven, CT: Yale University.
- Jackson, S.L. (2009). *Research Methods and Statistics: A Critical Thinking Approach* 3rd edition. Belmont, CA: Wadsworth.
- Jonsson, E. (2015, September 13). *A Brief History of Murals and Mural Painting*. Retrieved from Jonsson World: www.jonssonworld.com
- Kordic, A. (2015, September 11). *Mural the History and the Meaning*. Retrieved from Widewalls: <http://www.widewalls.ch/what-is-a-mural-the-history-and-meaning/>
- Lau, L. (2015, August 28). *The Murals of Mohammad Mahmoud Street: Reclaiming Narratives of Living History for the Egyptian People*. Retrieved from Boston University Arts & Sciences Writing Program: <http://bu.edu/Writingprogram>
- Cohen, L. et al (2010). *Research Methods in Education, Sixth Edition*. London & New York: Routledge.
- Nukunya, G. K. (2003). *Society, Culture and Modernization in Ghana*, Second and enlarged edition, Accra, Universities Press.
- Oliver, P. (2013, August 27). Purposive Sampling. Retrieved from Sage research methods: <http://srmo.sagepub.com>
- Pierce, L. L. (2009). Twelve Steps for Success in the Nursing Research Journey. *Journal of Continuing Education in Nursing*, 40(4):154-62.
- Qi, J. (2014). The Functions of Modern Mural Art. *Cross-Cultural Communication*, Vol 10, Iss 2, Pp 25-29.
- Wemegah, R. (2013). Murals in Sirigu Culture: Philosophical and Cultural Importance. *International Journal of Arts and Commerce*, Vol 2 No. 3, 108.

EMPLOYEE’S SAFE ACTS TOWARDS HEALTH AND SAFETY COMPLIANCE IN GHANA

Mustapha, Zakari; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington
Department of Construction Management and Quantity Surveying, Faculty of Engineering and Built Environment, University of Johannesburg, Johannesburg, Gauteng, South Africa

Abstract

The high incidents and accidents rate in the construction industry in Ghana has been attributed to the large number of Small and Medium-Sized Enterprises (SMEs) contractors. The purpose of the study was to examine employee’s safe acts that contribute to Health and Safety (H&S) compliance among SMEs contractors. The study adopted Delphi survey method of data collection. Views of experts (construction professionals and academicians) were sought on safe acts of workers leading to H&S compliance. The questionnaires were completed by the experts, based on the impact of other factors in predicting safe acts of workers towards H&S compliance. The ratings were based on either the impact was considered to be very high or high. Data obtained was analysed with Microsoft EXCEL, spread-sheet software and results were presented in a table and a chart. Findings from the study show that only three measurement variables (ensure equipment /tools are in good condition before usage, ensure the use of personal protective equipment (PPE) and ensure proper positioning of tasks) were considered by the experts to have reached consensus with Inter-quartile deviation (IQD) cut-off ($IQD \leq 1$) score. It also indicates strong consensus with very high impact (VHI: 9.00-10.00). Nine other measurement variables also reached consensus with IQD cut-off ($IQD \geq 1.1 \leq 2$) score, which indicates good consensus with high impact (HI: 7.00-8.99). The remaining four measurement variables reached consensus with IQD cut off ($IQD \geq 2.1 \leq 3$) score. It can be concluded from the findings that employee’s safe acts has a high impact on H&S compliance of SMEs contractors in Ghana. It is recommended that questionnaire survey instrument should be used among large construction firms to validate the measurement variables.

Keywords: Employee’s safe acts, Compliance, Health and Safety, SME contractors

1 Introduction

Small and Medium-Sized Enterprise (SMEs) contractors have dominated the construction industry in Ghana as indicated by Frempong and Essegbey (2006), Laryea (2010) Ofori and Toor (2012). Kheni, Dainty and Gibb (2007) posits that the domination of the SMEs has made it impossible for the SMEs to manage H&S effectively. Mustapha, Aigbavboa and Thwala (2015) in their findings from the study of the application of modified statistical triangle of accident causation in construction H&S indicated that construction accidents lead to delay in project completion, increase the expenses and ruin the reputation and reliability of contractors. These incidents have placed the construction industry among the industries with high rates of accidents, both permanent and non-permanent disabilities and even fatalities. Mustapha et al., (2015) posit that not all accidents are preventable since risk is beyond the human intervention and majority of accidents happen when employees disregard safety rules (unsafe acts) and

management ignore the presence of unsafe conditions. Employees must desist from acts such as, working under the influence of alcohol and other drugs. Appropriate use of PPE must be ensured by all employees whenever they are carrying out any task. The paper aims to examine employee's safe acts that will contribute to H&S compliance among SMEs contractors in Ghana. Employees' attitude towards H&S compliance in the construction industry has been discussed.

2 Literature Review

The employers and employees have similar perceptions of the respective responsibilities of each party for H&S in the workplace (Elgood, Gilby & Pearson, 2004) because H&S involves all levels of workforce, from the top to the bottom. Therefore, employees' involvement should be encouraged by management. It is important to establish participation, communication and trust between the various role players in order to create a positive safety culture (Boshoff, 2015). Smallwood and Haupt (2008) argued that compliance with OSH regulations brings about benefits not limited to avoiding direct and indirect costs (Windapo & Oladipo, 2012) also contributes to organisations' competitive advantages. According to Othman (2012) "inability to realise mechanical faults and inadequate training coupled with harsh work environment and unsafe methods of working *inter alia* are among the causes of non-compliance with OSH regulations in developing countries". Adenuga, Soyngbe, and Ajayi (2007); Idubor and Osiamoje (2013); Windapo and Oladapo (2012) supported this argument with lack of adequate training as a hindrance to OSH regulations compliance and further indicated that safe work environment can determine how issues of compliance with OSH regulations are taken care of by construction firms. Idubor and Osiamoje (2013) posits that adequate OSH training and education enhance the OSH performance e.g., compliance with OSH regulation. According to the Occupational Health and Safety (OHS) Act, the employer must, where reasonably practicable, provide and maintain a safe, healthy work environment that is without risk to employees (Boshoff, 2015). It is therefore, the duty of every employee at work to take reasonable care for the health and safety for himself as well as other persons. Every worker is in other words responsible to take care of his or her own health and safety. The unsafe acts of the worker may not negatively impact or endanger others (Boshoff, 2015).

One of the greatest determinants in workplace safety, especially as employees interact amid a host of varying safety issues is employers' behaviour. Elgood et al., (2004) argued that attitude is a key to understanding employee behaviour and prevention of on-site-job injuries. Therefore, it is the duty of employers' to educate their employees on the possibility of workplace injury before any safety program should be instituted (Schulz, 2004). Smallwood (2010) posits that employees' attitude relates to culture and can be linked to ignorance. If employees' attitude is checked it will lead to improvement towards H&S in the construction industry. Therefore, it is the responsibility of the employer on his employees to make provision a set of rules and regulations that relate directly to safety in the workplace to ensure the general wellbeing for employees (Elgood et al. 2004). The organization must undergo a culture change from the top and filter its way down to all employees for any sort of attitudinal change to occur to every employees (Schulz, 2004). Central to this culture is the feeling that safety is a top priority and nothing else. Employees' good attitude will contribute to their safe act which will finally lead to compliance of H&S in the construction industry. It is also the duty of employees' to cooperate with the employer where the OHS Act imposes a duty or requirement to be performed or complied with. Employees' should always carry out and obey lawful orders and obey the H&S rules and procedures laid down by the employer (Boshoff, 2015).

3 Research Methodology

Twenty (20) experts made up of academicians and construction professionals selected from Building Technologists, quantity surveyors were selected at random from West African Built Environment Research (WABER), International Conference on Infrastructure Development in Africa (ICIDA) and Applied Research Conference in Africa (ARCA) and invited during the initial stage of the study. The experts for the Delphi survey were selected for a purpose to apply their knowledge to a concept raised in the study based on the criteria that was developed from the research questions under investigation. A Delphi Study is a group decision mechanism requiring qualified experts who have deep understanding of the issues at hand (Okoli & Pawlowski, 2004).

Each expert was required to meet at least five (5) of the following minimum criteria: residency – have lived in any of the Metropolitan/Municipal/District in Ghana at least more than one (1) year; knowledge – has knowledge of H&S in the construction industry; academic qualification – has been presented an earned degree (Bachelors-degree/Masters-degree/PhD) related to any field, certification of employment/experience focusing on construction development or sustainable issues; experience – has a history of or currently performing consultation services for the government of Ghana, individuals, businesses, agencies, companies, and or organizations, relating to construction or other sustainable development. The experts must exhibit a high degree of knowledge of experience in the subject matter in addition to extensive theoretical knowledge, employment – currently serves (or has previously served) in a professional or voluntary capacity (e.g., at place of employment - institution, business, agency, department, company) as supervisor or manager of establish that is involved with construction or sustainable development in Ghana, influence and recognition - has served or currently serving as a peer reviewer for one or more manuscripts received from a journal editor prior to its publication in the primary literature, with focus of the manuscript(s) on construction or sustainable development, authorship - is an author or co-author of peer-reviewed publications in the field of construction with emphasis in Ghana, has prepared and presented papers at conferences, workshop or professional meetings focusing on construction, sustainable development and H &S, research - has submitted one or more proposals to or has received research funds (grant or contract) from national, local government, regional, and or private sources that support construction, sustainable development and studies related to H&S, teaching - has organised, prepared, and successfully presented one or more H&S or sustainable development training workshops focusing on the group for which expertise is sought. The workshop or course must have been on H&S practices or has served as an individual or as a collaborative instructor in the teaching of one or more Polytechnics or University courses focusing on construction, sustainable development or related field, membership -member of a professional body (as listed on the expert questionnaire). The expert should also be the representative of a professional body so that their opinions may be adaptable or transferable to the population and finally, willingness – Experts must be willing to fully participate in the entire Delphi survey. The selected experts for the paper represented a wide variety of backgrounds and guarantee a wide base of knowledge (Rowe, Wright & Bolger, 1991). Rowe et al., (ibid) recommendations were adopted for the current study. The number of respondents should be large enough to ensure that all perspectives are represented, but not so large as to make the analysis of the results unmanageable by the researcher (Linstone & Turoff, 1975). The adoption of five of these criteria was considered more stringent than the recommended number of at least two criteria by Rogers and Lopez (2002) and Dalkey and Helmer (1963). The five minimum criteria were framed after the four recommendations made by Adler and Ziglio (1996), with the inclusion of experts' residency status, which was considered to be compulsory for all selected experts. This was considered significant because experts were required to have a wide-ranging understanding of H&S practices within their locality.

From the twenty (20) experts invited to participate in the Delphi survey, thirteen (13) experts responded to participate and completed the first round, but only nine (9) experts remained throughout the study. This number of panellists was considered adequate based on literature recommendations from scholars which have employed the technique previously. Hallowell and Gambatese (2010) suggested that since most studies incorporate between eight (8) and sixteen (16) panellists, a minimum of eight (8) is reasonable. This was beyond the given limit in the current study. Hallowell and Gambatese (2010) argued that the size of a panel should be dictated by the study characteristics, number of available experts, the desired geographical representation and capacity of the facilitator. Experts were asked to rate the impact of other factors in predicting employees' safe acts in relation to their contribution towards H&S compliance as shown in Table 2. Data obtained from the survey was analysed with Microsoft EXCEL, spread-sheet software. The output from the analysis was a set of descriptive statistics such as means, median, standard deviations and derivatives of these statistics.

3.1 Instruction for experts

If the impact is considered to be high, then 'X' should be marked under the '7' or '8' box depending on whether your opinion is inclined more towards high or very high impact. Please use your experience, expertise and judgement to rate what you perceive the average negative or positive influence of the various features are for H&S compliance and the Ghanaian SMEs contractors at large would be if the described elements were lacking or present.

Table 1. Impact scale

No impact		Low impact		Medium impact		High impact		Very high impact	
1	2	3	4	5	6	7	8	9	10

4 Findings and Discussion

From the sixteen (16) measurement variables or attributes drawn from literature and considered most relevant for the study as shown in Table 2, only three measurement variables or attributes (ensure equipment /tools are in good condition before usage, ensure the use of personal protective equipment (PPE) and ensure proper positioning of tasks) were considered by the experts to have reached consensus with Inter-Quartile Deviation (IQD) cut-off ($IQD \leq 1$) score. This score implies the measurement variables have very high impact (VHI: 9.00-10.00) on employee's safe acts towards H&S compliance and indicates strong consensus. The results are in line with Mustapha et al., (2015), Othman (2012) and Elgood, Gilby & Pearson (2004) findings. Moreover, consensus was reached on nine other measurement variables with IQD cut-off ($1.1 \leq IQD \leq 2$) score. The IQD score indicates good consensus for the nine measurement variables and the impact on H&S compliance was high (HI: 7.00-8.99). Four measurement variables reached consensus with IQD cut off ($IQD \geq 2.1 \leq 3$) score, which indicates weak consensus on the measurement variables and impact on H&S was medium (MI:5.00-6.99). These findings further, indicate similar pattern reported earlier by Boshoff (2015), Windapo and Oladipo (2012), Othman (2012) and Smallwood and Haupt (2008) which emphasized on the need for education and appropriate training towards employee's safe acts. Using the median as a means of reaching consensus, fourteen (14) attributes were considered to have reached consensus, with the exception of two measurement variables (avoid annoyance and horseplay at the workplace and do not service equipment that is in operation) which did not reach consensus as shown in Tables 2 and their representation in Figure 1.

Table 2. Employee's Safe Acts

Employees' Safe Acts	Median	Mean	SD	IQD\leq 1
Inspect workplace before commencing any activity	9	7.86	1.73	1.36
Tidy up workplace at the end of any activity	7	6.5	1.71	2
Use appropriate tools/equipment	8	7.57	1.5	2.25
Do not work under the influence of alcohol and other drugs	8	8.14	1.46	2.25
Do not smoke in flammable materials store	9	8.43	1.68	2.5
Ensure equipment /tools are in good condition before usage	9	8.14	1.36	1
Use correct proper lifting, handling or moving of objects	8	7.86	1.36	1.36
Ensure proper stacking of objects /materials in safe locations	8	7.57	1.4	1.07
Avoid annoyance and horseplay at the workplace	6	6.57	1.84	1.5
Ensure the use of personal protective equipment (PPE)	9	9	0.93	0.25
Do not remove safety guards from the workplace or equipment	8	7.87	1.25	1.25
Do not throw or accidentally drop objects from high levels	7	7.43	1.51	1.5
Ensure proper positioning of tasks	7	7.29	1.38	1
Do not service equipment that is in operation	6	6.14	2.61	2.5
Concentrate on the task at hand	7	7	2	2
Work in good physical conditions	8	8.29	1.5	2

M = Median; \bar{x} = Mean; σ_x = standard deviation; IQD = Interquartile deviation

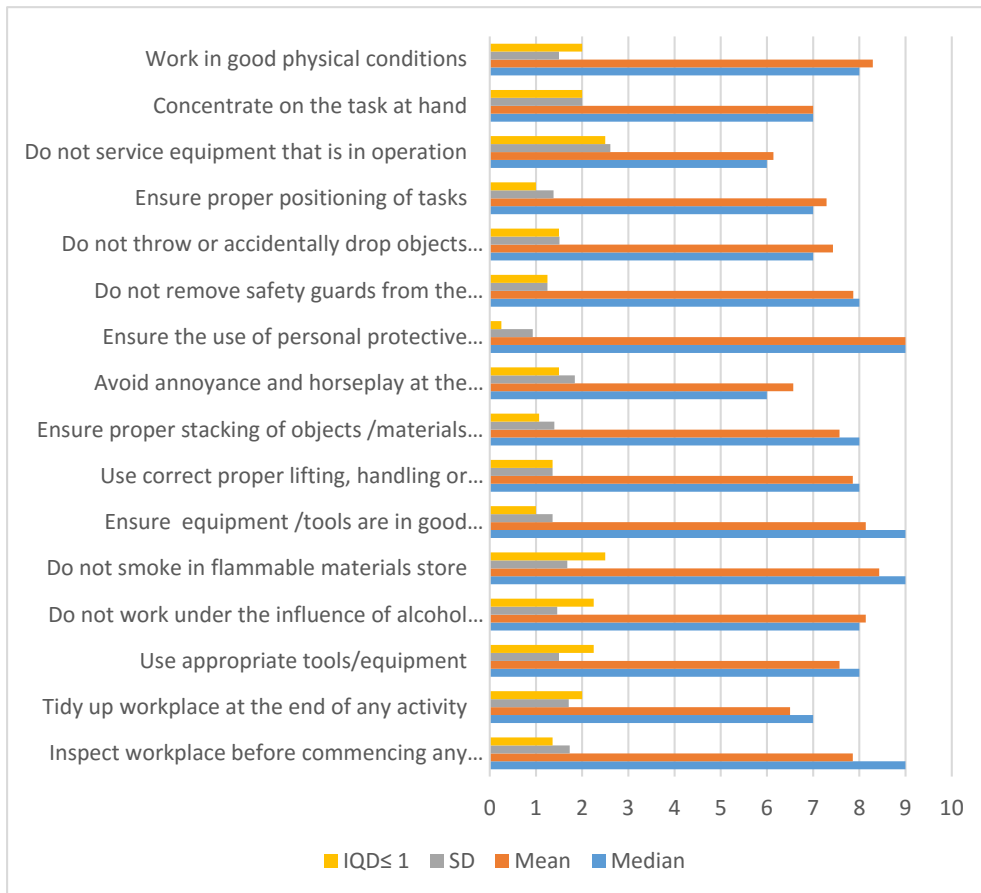


Figure 1. Employee's safe acts

Results from the study revealed that the following sixteen factors or measurement variables were considered by the experts to have varying impact on the employees' safe acts towards H&S compliance.

1. Inspect workplace before commencing any activity (HI)
2. Tidy up workplace at the end of any activity (HI)
3. Use appropriate tools/equipment (MI)
4. Do not work under the influence of alcohol and other drugs (MI)
5. Do not smoke in flammable materials store (MI)
6. Ensure equipment /tools are in good condition before usage (VHI)
7. Use correct proper lifting, handling or moving of objects (VHI)
8. Ensure proper stacking of objects /materials in safe locations (HI)
9. Avoid annoyance and horseplay at the workplace (HI)
10. Do not service equipment that is in operation (MI)
11. Ensure the use of personal protective equipment (PPE) (VHI)
12. Do not remove safety guards from the workplace or equipment (HI)
13. Do not throw or accidentally drop objects from high levels
14. Ensure proper positioning of tasks (VHI)
15. Concentrate on the task at hand (HI)
16. Work in good physical conditions (HI)

From the impact ratings of the factors, findings revealed that 3 of the factors or measurement variables have a very high impact (VHI: 9.00-10.00), while 9 other factors or measurement variables have high impact (HI: 7.00-8.99) and four other factors or measurement variables have medium impact.

5 Conclusion and Further Research

The purpose of the study was to examine employee's safe acts that contribute to H&S compliance among SMEs contractors. It was concluded from the findings that employee's safe acts have high influence on H&S compliance of SMEs contractors in Ghana. Further research will be conducted using a questionnaire survey instrument to evaluate the validity of the factors or measurement variables among large construction firms.

6 References

- Adenuga, O.A., Soyngbe, A.A., and Ajayi, M. A. (2007). A study on selected safety measures on construction Companies in Lagos, Nigeria, *RICS (Cobra)*.
- Adeogun, B.K. and Okafor, C.C. (2013). Occupational Health, Safety and Environment (HSE) Trends in Nigeria. *International Journal of Environmental Sciences, Management and Engineering Research*, Vol. 2 (1), pp. 24-29, Jan- Feb. Available from <http://www.ijesmer.com> [accessed 02 July 2014].
- Boshoff, T. (2015). Health and Safety and the Employment, *The South African Labour Guide*. Available from <http://www.labourguide.co.za/> [accessed 08 October 2015].
- Elgood, J., Gilby, N. and Pearson, H. (204). Attitudes towards Health and Safety: A Quantitative Survey of Stakeholder Opinion, MORI Social Research Institute.
- Frempong, G. and Essegbey, G. (2006). Towards an African e- Index, SME e-ACCESS AND USAGE across 14 African countries, Available from <http://www.researchictafrica.net> [accessed 30 September 2014], pp. 25-27.
- Hallowell, M.R. and Gambatese J.A. (2010). "Qualitative research: application of the Delphi method to CEM research." *Journal of Construction Engineering and Management*, ASCE, Vol. 136 (1), pp. 99-107.
- Idubor, E.E. and Oisamoj, M.D.* (2013). An exploration of health and safety management issues in Nigeria's effort to industrialise. *European Scientific Journal* April 2013 edition, Vol. 9 (12) ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431, p.159.
- Kheni, N.A, Dainty, A.R.J. and Gibb, A.G.F. (2007). Influence of political and socio-cultural environments on health and safety management within SMEs: a Ghana case study. *In: Boyd, D (Ed) Proceedings of the 23rd Annual ARCOM Conference, 3-5 September 2007, Belfast, UK, Association of Researchers in Construction Management*, pp.159-168.
- Laryea, S. (2010). Health and safety on construction sites in Ghana: In :*The Construction, Building and Real Estate Research Conference of the Royal Institute of Chartered Surveyors, Dauphine Université, Paris, 2-3 September. Dauphine Université, Paris, France.* Available from entaur.reading.ac.uk [accessed on 24 February 2015].
- Mustapha, Z. Aigbavboa, C. O. and Thwala, W.D. (2015). Application of Modified Statistical Triangle of Accident Causation in Construction Health and Safety, © Springer-Verlag Berlin Heidelberg 2015 L. Shen et al. (eds.), *Proceedings of the 19th International Symposium on Advancement of Construction Management and Real Estate*, DOI 10.1007/978-3-662-46994-1_6, pp.57-66.
- Ofori, G. and Toor, S.R. (2012). *Journal of Construction in Developing Countries, Leadership and Construction Industry Development in Developing Countries*, Available from <http://web.usm.my/jcdc> [Accessed 20 May 2015].

- Schulz, D. (2004). "Employee Attitudes: A must have. Occupational Health and Safety," Vol. 73(6), pp. 66-71.
- Othman, A. A. E. (2012). A study of the causes and effect of contractors' noncompliance with the health and safety regulations in the South African construction industry. *Architectural Engineering and Design Management*, Vol.8, pp.180-191.
- Smallwood, J.J (2010). "Excavation health and safety (H&S): a South African perspective". *In: Egbu, C. (Ed) Procs 26th Annual ARCOM Conference, 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, pp. 233-241.*
- Smallwood, J. Haupt, T and Shakantu (2008). Construction Health and Safety in South Africa: Status and Recommendation, *CIDB report*.
- Windapo, A. and Oladapo, A. (2012). Determinant of construction firms' compliance with health and safety regulations in South Africa *In: Smith, S.D (Ed) Procs 28th Annual ARCOM Conference, 3-5 September 2012, Edinburgh, UK, Association of Researchers in Construction Management, pp.433-444.*

PERCEIVED RISK IMPACT ON MARKETING OF CONSTRUCTION PROFESSIONAL SERVICES

Ojo, Grace Kehinde; Ebunoluwa, Esther Ilori

Department of Quantity Surveying, Faculty of Environmental Design and Management, Obafemi Awolowo University, Ile-Ife, Osun State, Nigeria

Odediran, Sunday Julius

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, Western Cape, South Africa

Abstract

Risk is inevitable in all aspects of life including the construction industry. Its impact is evident in every activities of construction in which marketing of professional services cannot be left out. Therefore, this paper examined the impact of risk on marketing of the services rendered by the construction professionals with a view to enhancing their marketing outcome. Twenty- one risk factors were identified for assessment by the construction professionals through the administration of questionnaire. Architects (72), Engineers (91) and Quantity Surveyors (73) were systematically selected in Lagos State, Nigeria. Data collected were subjected to relative importance index (RII) and factor analysis. Close competition between the client and other competitor was the most significant risk associated with the marketing of construction professional services followed by tough competition. The result of factor analysis reduced the identified risks into five major factors; which were related to clients' expectation, stakeholders' relationship, cost related, ethics and government influence and economic-related factor. The study concluded that the impact of client professional relationship has a high impact on the marketing of construction professional services. Therefore, it is recommended that these factors should be given adequate and prompt consideration in order to reduce its adverse effects on the marketing objectives.

Keywords: Construction professionals, Marketing, Professional services, Risk

1 Introduction

Marketing is an important function for the success of companies. Effective marketing plays an important role in the overall success of companies and is critical for any business to grow in the competitive business environment. Developing marketing strategies can provide significant advantages for companies over their competitors. However, as Cicmil and Nicholson (1998) stated, many companies do not realize the true worth of marketing until it is too late to change. Professional service providers are qualified advisors and problem solvers, even though it may encompass some routine work for clients. Marketing, according to United States Department of Agriculture (USDA n. d), is that part of the business that transforms production activities into financial success. It usually helps construction companies to differentiate themselves from their competitors, cultivate and/or keep clients, and thereby create competitive advantage. A professional association needs to market the profession for a number of key objectives as established by Allred (2005). Marketing makes the public aware of the services offered and

also increase familiarity among client. Moreover, risk is evitable in all aspects of life including construction activities. Marketing is one of the construction activities which is not an exception that is being impacted by risk. Risk according to Bowen and Edward (1998) is the probability that adverse effects will occur during a stated period of time. Also, Ojo (2010) established that risk is the probability that unfavourable outcome will occur. Risk is an important issue to contractors as well as clients and consultants in the industry due to its inevitability in all aspects of construction. The amount of fee allocated to marketing exercise by any organization will determine the level of benefits to be derived from marketing their services. Despite the fact that marketing is being practice among the professionals, yet they still face a lots of challenges due to the level of competition experienced, therefore, it is of importance that appropriate strategies should be adopt in order to improve the profits and attract higher patronage. Although, the purpose of this research is to examine the risk associated with the services rendered by the construction professional in the area of marketing.

2 Literature review

The professionals in the construction industry bring together expertise and skill to work towards a common goal of satisfying their client. Hussin and Omran, (2009) described construction professionals as the Architect, Engineer and Quantity Surveyor among others. The construction professionals are known to be the most responsible person in a project especially when technical works are concerned. The expertise of each construction professionals must be careful in providing their services as they are answerable to any sinfulness occurred during the constructions.

2.1 Related Studies on Risks and Marketing of Construction Professional Services

Many researchers have worked on the concept of marketing in the construction industry. Morgan (1990) investigated marketing of consulting engineering services and discovered that very few firms had their own marketing departments. Philip and Richard (1977) investigated marketing professional services and found that professionals would like to believe clients would come to them without any organized effort on their part, simply as a result of achieving a good reputation, and that they do not have competitors or that other firms are not aggressively cultivating the same pool of clients. They posit that professional firms that want to grow and prosper will have to shed this attitude and confront the marketing issues and challenges. Ojo (2011) proposed effective marketing strategies among the construction professionals and concluded that the level of practice of marketing among professionals in Nigerian construction industry was very low and inadequate compared to the level and keenness of competition in Nigerian construction industry.

Need for marketing of construction professional services was carried out by Allred (2005) and found out that it improved familiarity among the clients, improved profitability, brings better sales among others. The research did not considered the risk that come along with the marketing of the activities performed by the professionals. In addition, Olujide (2002), Allred (2005) and Ojo (2012) studied marketing strategies employed by construction professionals but did not considered the risk that actually come with each of the strategies. Despite the fact that many research works on marketing exist, few have been recorded on risks associated with the marketing of professional services in construction industry. Hence, this research work will focus on risk factors that influence the marketing of construction professional services in Lagos State, Nigeria.

2.2 Risk Factors associated with the Marketing of Construction Professional Services

Professional Architects, Engineers, Quantity Surveyors, project managers and other consultants often find themselves doing work which could expose them to legal liability. Yet

few understand the risks to which they are exposed or the standard of skill and care which the law expects (Alan n.d). Ojo (2010) emphasized that the effect of risk is assessed through the risk factors. Factors that influence marketing of any business were identified from literature (Table 1), meanwhile risk can be assessed through their factors and risk is anything that has negative effects on any outcome of an exercise, therefore, those factors are seen as risk associated with the marketing of construction professional services. For example, Pheng (2003) opines that high spending level of customer is one the factors that limits the services of the construction professionals. This is so, since net disposable income of the customers (Clients) is the primary element that contributes to the sales of any product in the target market.

Furthermore, high level of clients' awareness, inconsistent Government policies as revealed by (Hoxley, 1998; Smyth, 2004) are risks associated with the marketing of professional services. The intelligent or sophisticated client has previous experience of purchasing professional services and enters into each new service encounter with preconceived ideas of what to expect. Also, government policies affects the services rendered by the professionals. Assaults on Professional codes of ethics are another risk factor that limits the marketing of the services rendered by the construction professionals. This is so as the services rendered by professionals such as the Quantity Surveyors are affected by the rules against advertising at least to some extent. According to Philip and Richard (1977), association codes of ethics have erected stringent rules against commercial behaviour. In addition, changing expectations of clients is considered as a risk factor by Geraldine (2006) who reported an important change in customer expectations, which actually influenced the professional's response to these new conditions.

Likewise, tough competition experienced by the construction industry makes it a major task for the professionals in marketing their services. The table below shows the identified factors that influencing the marketing of any business which the study perceived to be the risks impacting marketing of construction professional services.

Table 1. Factors influencing marketing identified from literature

Risk factors	Author(s)
<i>High spending level of Customer</i>	Smyth, 2004
<i>High cost of investing on Electronic Commerce</i>	Brassington & Pettit, 2003; Pheng, 2003
Inconsistent Government Policies	Pattulo, 2003
<i>High cost of innovating products</i>	Smyth, 2004; Bennett, 2005
<i>Rapid increase of Consumer Demand</i>	Geraldine, 2006
Demographic factors	Pheng, 2003
Unavailability of Land and Restriction from the Government	Pettinger, 1998; Pattulo,2003
High level of Clients' awareness	Hoxley, 1998; Basil, 2009
Tough competition	Powell et al., 1999
Lack of infrastructure	
Poor power supply	
Changing clients' expectation	Philip & Richard, 1977; Geraldine, 2006
Assaults on professional Codes of Ethics	
Disdain for Commercialism	Hanlon, 1994
Association Codes of Ethics	Philip & Richard, 1977
Inadequate security	
Close relationship between the client and competitor	
Escalating high cost of technology	Geraldine, 2006
Globalisation	Geraldine, 2006
Increased material costs and labour shortages	
Transportation challenges	

3 Research Methodology

This research makes use of quantitative approach since those factors were perceived to be risk impacting marketing of construction professional services. Total population for the study were 538 professionals which were stratified into three groups comprising of 161 Architectural firms, 168 Quantity Surveying firms and 209 Engineering firms (ARCON, 2008; QSRBN, 2010 and COREN, 2008) respectively cited in Babatunde (2011). Systematic sampling was then used to select a sample from the total population. To calculate the required sample size for this study, the study followed the submission of Trochim (2000) that 10-30% is adequate for a small population and as low as 1% is adequate for a large population. The calculation of the required sample size is according to Equation (1):

$$n = \frac{t^2 \times p \times (1 - p)}{m^2} \quad \text{----- (1)}$$

Where, n = required sample size

t = confidence level at 95% (standard value of 1.96)

p = estimated professional firms in the study area expressed as decimal 0.3 (30%)

m = margin error at 5% (standard value of 0.05)

Therefore,

$$\begin{aligned} n &= \frac{1.96^2 \times 0.3 \times (1 - 0.3)}{0.05^2} &= & \frac{3.8416 \times 0.3 \times (0.7)}{0.0025} \\ &= \frac{3.8416 \times 0.21}{0.0025} &= & \frac{0.8067}{0.0025} \\ &= 322.68 &= & 323 \end{aligned}$$

From the above calculation, three hundred and twenty three (323) firms were sampled indicating that 323 questionnaire were administered on professionals in the Architectural firms, Quantity Surveying firms and Engineering firms in the study area. The retrieved and fully completed questionnaire comprised (72) architects, (91) engineers and (73) quantity surveyors which is equivalent to 73.07% response rate. This can be considered adequate following the assertion of Morsan and Katon, (1979) that a study could be considered little or no value if the response rate is less than 30-40%. Moreover, Relative Importance Index (RII) and Factor analysis were used to analyse the data collected. Relative Importance Index (RII) was used to reflect the significant measurement of the factors. This method of analysis has been employed by many construction management researchers including Akintoye (2000); Wang *et al* (2001) and Odeyinka (2003).

All the numerical scores of each of the identified factors were transformed to risk indices to determine the relative ranking of the factors. Relative Importance Index (RII) was evaluated using the expression in equation (2):

$$RII = \frac{\sum w}{A \times N} ; \quad (0 \leq \text{index} \leq 1) \quad \text{----- (2)}$$

Where: w = weighting given to each factor by the respondents, and ranges from 5 to 0

A = highest weight (i.e. 5 in this case) and N = total number of respondents.

Furthermore, factor analysis was also used to reduce the variables to a few that represents some combination of original variables by factor extraction. According to Fellows and Liu (2003), such factor extraction is done by means of principal components; which transforms the original

set of variables into a smaller set of variables. The extracted factors were named based on the loading items upon which generalization is being made.

4 Findings and Discussion

4.1 Background Profile of the Respondents

The result from Table 1 shows that 40.3% of the registered firms are engineering companies, 30.9% are Quantity Surveying and 28.4% Architectural. Also, the highest respondents as showed on the table were Engineers (38.56%), 30.93% are Quantity Surveyors while 30.51% of the respondents came from Architects. The Table 1 also shows that 33.5% of the respondents are member of NSE, 32.2% are member of NIQS and 32.2% are member of NIA. This shows that 97.9% are members of particular professional bodies; therefore, they are able to provide vital and adequate information necessary for this study. From Table 1, it may be seen that the entire respondent had minimum of HND and others with higher degree had B.Sc. degree holders (66.1%). None of the respondents possess a qualification below HND; hence the respondents are qualified to practice in their respective professional and are therefore deemed competent to provide the needed information for the study.

Table 2. General particulars of the Respondents

Respondents' particulars	Frequency	Percentage (%)
<u>Types of Firms</u>		
No response	1	0.4
Architecture	67	28.4
Engineering	95	40.3
Quantity Surveying	73	30.9
Total	236	100.0
<u>Designation of Respondents</u>		
Quantity Surveyors	73	30.93
Engineers	91	38.56
Architects	72	30.51
Total	236	100.0
<u>Professional Affiliation</u>		
No response	5	2.1
NIQS	76	32.2
NIA	76	32.2
NSE	79	33.5
Total	236	100.0
<u>Academic Qualification</u>		
HND	50	21.2
B.Sc.	156	66.1
M.Sc.	24	10.2
Ph.D	5	2.1
Others	1	0.4
Total	236	100.0
<u>Professional Experience</u>		
No response	3	1.3
1-5	47	19.9
6-10	107	45.3
11-15	70	29.7
Over 20	9	3.8
Total	236	100.0
<u>Number of Employees</u>		
No response	2	0.8
1-5	41	17.4
6-10	102	43.2
11-15	50	21.2
16-20	25	10.6
>20	16	6.8
Total	236	100.0
<u>Types of Work Engaged</u>		
Building construction	105	44.49
Civil engineering construction	63	26.70
Both building & Civil engineering construction	51	21.61
Industrial engineering construction	17	7.20
Total	236	100

(Source: Authors' fieldwork, 2015)

4.2 Perception of the Impact of Risk Factors on the Marketing of Construction Professional Services

The study sought to know the impact of the identified risk factors on the marketing of construction professional services. Relevant data collected in this regard is presented in Table 3. Result from Table 3 indicates that 10 factors out of 21 factors (48%) have a high impact on marketing outcome of construction professional services. The result shows that the factors with very high impact are close relationship between the client and other competitors, followed by tough competition, inconsistent government policies, association codes of ethics, and unavailability of land and restriction from the government. Unavailability of land (expensive amount of land, approval etc) in Lagos State limited the amount of services to be rendered by the professionals due to the fact that clients were unable to purchase and the time awaiting for the government approval. This finding is because the impact of these factors on marketing of the services of construction professionals is aligned to the findings of previous studies available in literature (Hoxley, 1998; Pheng, 2003 and Geraldine, 2006).

Table 3. Impact of the Identified Risks on the Marketing of Construction Professional Services

Risk Factors	RII	Rank
Close relationship between the client and competitor	0.78	1
Tough competition	0.75	2
Inconsistent Government Policies	0.66	3
Association codes of ethics	0.64	4
Unavailability of Land and Restriction from the Government	0.60	5
Changing clients' expectation	0.58	6
Assaults on professional Codes of Ethics	0.57	7
High level of Clients' awareness	0.57	7
High spending level of Customer	0.56	9
High cost of investing on Electronic Commerce	0.51	10
Increased material costs and labour shortages	0.49	11
Poor power supply	0.49	11
High cost of innovating products	0.49	11
Transportation challenges	0.48	14
Lack of infrastructure	0.47	15
Escalating high cost of technology	0.45	16
Inadequate security	0.45	16
Rapid increase of Consumer Demand	0.43	18
Disdain of Commercialism	0.42	19
Demographic factors	0.39	20
Globalisation	0.36	21

Key: RII = Relative Importance Index; R = Rank

4.3 Results of the Factor Analysis Performed

Table 4 shows the result of factor analysis conducted. The factor analysis reduced the identified risks to five major risk factors that were found to have very high impact on marketing of construction professional services. The extracted risk factors were identified as economic related risk, cost related risk, ethics and government influence risk, clients' expectation related risk, and stakeholders' relationship risk. It was observed from Table 4 that the first dominant factor accounting for 30.08% of the observed variance and all the five factors accounted for 64.03% of the observed variance. This shows that the factors identified by factor analysis have very high impact on marketing of construction professional services. The Table also shows

how the items loaded to factors after rotation. The cumulative percentage of variance explained by the first five factors is 64.03%, in other words, 64.03% of the common variance shared by the 21 variables can be accounted for by the five factors.

Table 4. Rotated component matrix component

S/N	Marketing related risk	1	2	3	4	5	Mean Values	Rank
	Economic-related risk						0.6499	5
1	Poor power supply	0.736						
2	Lack of infrastructure	0.692						
3	High spending level of Customer	0.680						
4	Transportation challenges	0.662						
5	Escalating high cost of technology	0.632						
6	Rapid increase of Consumer Demand	0.622						
7	Globalization	0.525						
	Cost-related risk						0.6740	3
8	High cost of investing on Electronic Commerce		0.793					
9	High cost of innovating products		0.701					
10	Demographic factors		0.693					
11	Increased material costs and labour shortages		0.509					
	Ethics and government influence risk						0.6540	4
12	Inconsistent Government Policies			0.682				
13	Association Codes of Ethics			0.671				
14	Assaults on professional Codes of Ethics			0.658				
15	Unavailability of Land and Restriction from the Government			0.605				
	Clients' expectation-related risk						0.7280	1
16	Inadequate security				0.789			
17	Changing clients' expectation				0.726			
18	Disdain of Commercialism				0.669			
	Stakeholders' relationship risk						0.7075	2
19	High level of Clients' awareness					0.718		
20	Tough competition					0.708		
21	Close relationship between the client and competitor					0.697		
<i>Eigenvalue =</i>		<i>6.32</i>	<i>3.10</i>	<i>1.57</i>	<i>1.35</i>	<i>1.11</i>		
<i>% of variance =</i>		<i>30.08</i>	<i>14.78</i>	<i>7.46</i>	<i>6.45</i>	<i>5.26</i>		
<i>Cumulative % =</i>		<i>17.67</i>	<i>31.75</i>	<i>43.99</i>	<i>54.93</i>	<i>64.03</i>		

Also, the result revealed that all the reduced factors had very high mean value ranging from 0.7280 – 0.6499 which indicates their high level of impact on the marketing of construction professional services. Clients' expectation related risk had the highest mean value (0.7280), this implies to mean that, client/client executives are becoming more sophisticated in selecting, using, increasingly, and replacing firms. The second rank was stakeholders relationship risk (mean value = 0.7075). Good relationship between the client and the competitor hinders some

qualified professionals from achieving their aim even with effective marketing, thereby making it one of the biggest challenges facing the professionals in marketing their services.

5 Conclusion and Further Research

Based on the aim of this study, which set out to examine the impact of risk factors on the marketing of construction professional services in order to enhance marketing outcome, the following conclusions were made from the results of the analysis of data contained in the previous discussions. Three of the identified risk factors had very high impact on the marketing of construction professional services. These factors included close relationship between the client and other competitors, tough competition and inconsistent government policies. Furthermore, factor analysis reduced identified variables to few components, these included cost related factor, ethics related factor and government influence factor. The research work focused on Lagos State as the study location, further research can examine other locations within the country. Other professionals not captured in this research can also be the focus of future research.

6 Recommendations

Marketing activities should be more encouraged among construction professionals by improving on the fee allocated to marketing related activities. Also, construction professionals should use appropriate strategies in order to improve profit and attract higher patronage. Significant risk factors should be given adequate consideration by the construction professionals in order to reduce the occurrence and negative impacts on the marketing outcome of their professionals' services.

7 References

- Alan B. (n.d). Negligence and Liability of Professionals in Construction, www.google.com, accessed on 28th April 2014.
- Allred, K. (2005). Marketing the Profession, Some strategies that work. From Pharaohs to Geoinformatics FIG Working Week 2005 and GSDI-8 Cairo, Egypt April 16-2.
- Bowen, P. A. and Edward, P. J. (1998). Risk and risk management in construction: A review and future directions for research. *Engineering, Construction and Architectural Management*, 5(4), 339-349.
- Charles .Y. (2000). Risk analysis framework for cost estimation in association with planning and management consultant ltd, South U.S. Accessed online on April 26th 2014.
- Cicmil, S., and Nicholson, E. (1998). The role of the marketing function in operations of a construction enterprise: misconceptions and paradigms''. *Management Decision*, Vol. 36, No. 2, pp 96-101.
- Geraldine, T. C. (2006). *Barriers to Marketing within Professional Service Firms. A Study of the Understanding and Application of Marketing within Accountancy and Law Firms*. A Ph.D. thesis, Brunel Business School, Brunel University, June.
- Hussin, A .A. and Omran, A. (2009). Roles of Professionals in Construction Industry. *The International Conference on Economics and Administration*, Faculty of Administration and Business, University of Bucharest, Romania ICEA – FAA Bucharest, 14-15th November.
- Hoxley, M. (1998). *The Impact of Competitive fee Tendering on Construction Professional Service Quality*. Ph.D, Thesis Time Research Institute Department of Surveying University of Salford, Salford, UK.
- Morgan, R. E. (1990). Marketing Professional Services: an empirical investigation into consulting engineering services. *Proceedings of the Annual Conference of the Marketing Education Group*, Oxford Polytechnic. Pp. 973–995.

- Odeyinka, H.A. (2003). *The development and validation of models for assessing risk impacts on construction cash flow forecast*, Ph.D Thesis, Glasgow Caledonian University.
- Ojo, G.K. (2011). Effective Marketing Strategies and the Nigerian Construction Professionals. *African Journal of Marketing Management*. Vol. 3(12), pp. 303-311, December 2011
- Patrick, X.W., Guomin, Z., and Jia-Yuan W. (2005). *Identifying Key Risks in Construction Projects: Life Cycle and Stakeholder Perspectives*. Faculty of Built Environment, University of New South Wales, Sydney 2052, Australia, College of Architecture and Civil Engineering, Shenzhen University, Shenzhen, P.R. China.
- Pheng, L. S. (2003). The extension of construction partnering for relationship marketing, *Marketing Intelligence & Planning* 17/3 [2003] 155160.
- Philip, K. and Richard C. A. (1977). Marketing professional services, a specific program for manager of professional services firms, *Journal of Marketing*. 41(1): 71-76.
- Powell, T. C. and Dent-Micallef A. (1999). Information technology as competitive Advantage: the role of human, business, and technology resources." *Strategic Management Journal*. 18(5), 375-405.
- Smyth, H. (2004). Effective selling of design and build: architecture as a sales strategy, in, COBRA „96, Royal Institution of Chartered Surveyors, *Proceedings of the Annual Conference*.

STAKEHOLDER MANAGEMENT; A LITERATURE REVIEW OF HISTORICAL DEVELOPMENT AND CURRENT TRENDS

*Eyiah-Botwe, E.; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington
Department of Construction Management and Quantity Surveying, Faculty of Engineering and Built Environment, University of Johannesburg, Johannesburg, Gauteng, South Africa*

Abstract

Effective and formal stakeholder management process is critical in achieving stakeholder needs and satisfaction, an important project success factor. Developed countries construction industries have embraced stakeholder management as a soft project management skill and consequently developed suitable approaches for improved project delivery though developing countries are yet. Studies have associated project failures to poor stakeholders' performance, the absence of formal stakeholder management process, industry challenges and lack of proper documentation in developing countries such as Ghana. This study identifies, reviews and documents the historical development of stakeholder management process in Ghana as part of a broader study aimed at “developing sustainable stakeholder management framework for construction process in developing countries” for enhanced project success. An exploratory method with the qualitative technique was adopted. A literature review was conducted into stakeholder management practice to explore the trend, influence of historical development and documentation of stakeholder management process in relation to industry challenges using three countries as case studies. This is aimed at documenting and developing sustainable stakeholder management process for developing countries. A descriptive survey was used for analysis and documentation. Findings are that formal documentation of industry practices, procurement challenges, stakeholders role in project failures led to the reviews and stakeholder focused reports which that advocated for collaboration. A trend which has influenced the development of stakeholder management process. In the absence of formal documentation, the study identified and documented stakeholder management historical development trend in Ghana for the development of a stakeholder management framework.

Keywords: Construction industry, Developing countries, Ghana, Historical development, Stakeholder management

1 Introduction

Construction projects by their diverse nature have individuals and organizations actively involved in the project, or whose interest may be positively or negatively affected by the project outcome (Gardiner, 2005). Studies have revealed that stakeholders can contribute to project success or failure (Newcombe, 2003). The question has been who are these stakeholders, what are their interest and how should they be managed? Strategic management, a stakeholder approach by Edward Freeman in 1984 has been acknowledged as the beginning of stakeholder theory and concept in management circles. In the past two decades, there has been increasing research into stakeholder management due to its positive impact on project delivery (Yang, 2010). Chinyio and Olomolaiye (2010) suggest that there are several but no formal approaches

to stakeholder management by many construction industries. Mok et al., (2015) states that the culture of a nation and the construction industry environment impact on the stakeholder management process and project outcome. Stakeholder management is essential to achieve stakeholder needs and satisfaction (PMI, 2013). Nevertheless, studies have identified several approaches to stakeholder management process (Walker et al., 2008).

Stakeholder Management (SM) varying approaches can partly be attributed to the different construction industry practices, culture, environment and historical developments. Jurgens et al., (2010) differentiates between stakeholder theory and practice in Europe and North America as following different trends. Developed countries have adopted different SM approaches for construction projects, a trend aimed at solving construction industry challenges and practices (Beach, 2009). The UK and Finland are examples of countries where SM has largely been embraced and used to enhance project delivery (Chinyio and Akintoye, 2008). In contrast, many projects undertaken in developed countries such as Ghana fail to meet their delivery targets, a situation also attributed to stakeholder roles in project delivery (Auditor General Report, 2013). Although development interventions are crucial for socio-economic growth, developing countries are yet to embrace SM formally as a project management skill for improved project delivery, a situation partly attributed to the absence of historical documentation on the industry.

The aim of this study is to identify and review historical developments in the construction industry and its influence of stakeholder management development processes. It seeks to address three objectives of (1) reviewing stakeholder management theory and trend, (2) review stakeholder management process in selected developed countries and the influence of the historical development (3) review, document industry's and stakeholder management historical development processes in Ghana for the "development of sustainable stakeholder management for construction projects in Ghana". A qualitative research approach was adopted. The literature on stakeholder management including historical development and current trends were reviewed. A case study of three countries were considered, and the influence by historical development noted. A descriptive survey was employed for presentation and analysis. Findings are that stakeholder's role in project failures led to the establishment of committees and reports which are stakeholder focus and developed into SM process. In the absence of formal documentation in Ghana, this study identifies and documents historical development of stakeholder management trend in Ghana as a developing country for improved project delivery.

2 Literature review

2.1 Construction industry

The nature and outcome of the activities of a nation's construction industry are significant for several reasons. These include contributions to the nation's socio-economic development, provision of physical infrastructure for the needed productivity, housing for shelter, education, health and civic responsibilities (Ofori, 2012). The construction industry contributes significantly to the gross domestic product (GDP) of a nation. Chinyio and Olomolaiye (2010) suggest that the relatively low productivity growth of UK's construction industry constantly attracted the UK's government's attention. Similarly in South Africa, the construction industry's low performance in 2013 following highs in 2012 and global recession was a major concern (South African Publication, 2013). It is generally believed that the industry contributes about 5-10% of GDP of all nations (Ofori, 2012). According to UKCG (2009), "The construction industry is a driver of growth in other sectors due to its heavy reliance on an extended and varied supply chain and contributes about 8-10% of UK's GDP. The industry's contribution towards GDP of nations, therefore, cannot be underestimated.

Global statistics indicates an estimated 7 - 10% of the global workforce works in the construction industry (Mwanaumo; 2012, Murie, 2007; ILO, 2005). The large size of the industry affects the growth of the economy due to its labor employment. Further, it is noted as a key sector of every economy and depending on the government, can be an economic regulator (Ofori, 2012; Hillebrandt, 2000). According to OGC (2009), the UK construction industry is a driver of growth of other sectors. Following the Latham (1994) and Egan (2002) reports, the UK construction industry has adopted a trend which is stakeholder focus thus embracing stakeholder management process. Similarly, the realization of the strategic role of the sector in socio-economic growth in South Africa aided the construction industry development board (cidb) establishment which regulates the industry and promotes stakeholder collaboration.

Harris (2010) has suggested that the formal historical reviews have resulted in the different forms of contract development and stakeholder interactions: separated, management, integrated and discretionary. These newly developed contracts are more stakeholder focus, have all key players such as the client, project manager, designers, contractors and supply chain tied in by formal contract, a trend aimed at enhancing stakeholder management and achieving stakeholder satisfaction. Rwelamila and Savile (1994) state that construction projects must be considered in relation to the environment; country, location and project type. There is a relationship and impact of procurement method on stakeholder management with the different contracts placing different stakeholder responsibilities (Harris, 2010; Rwelamila, 2010). Projects cannot be established, accomplished and benefits gained without considering stakeholders (Eskerod and Jespen, 2013).

2.2 Developing Countries

Developing countries have lower economic, technological, education, inadequate health care, infrastructure development, high population growth and low per capita income (World Bank Report, 2012). Infrastructure construction is a development intervention vital for socio-economic growth. Ofori (2012) outlines the industry's impact on developing countries to include socio-economic development, 5-10% GDP contribution, complex linkages for development and has the ability to alleviate poverty. Nevertheless, the construction industry in many developing countries is neither organized nor controlled by firms and individuals building without the necessary government approval or adhering to the building codes, a practice which has led to the collapse of buildings (Oyedele, 2013). The industry is fragmented with several small and medium enterprise supply chain firms (Ofori, 2000). This has resulted in the on-going entry and exit of construction firms and supply chain organizations in the industry (Oyedele, 2013).

In Ghana, there is a proposal for the establishment of the Construction Industry Development Authority to regulate the industry (CIDA Bill, 2015). This is as a result of client dissatisfaction and unsatisfactory project delivery which also pertains to other developing countries. Othman (2013) identified the challenges of external funding dependence, low technology, low human resources and non-organized construction industry. Oyedele (2013) suggests that 80% of all construction industry project funding is from the public sector hence is affected by the economy's performance. Further, stakeholders of different background impact on resources, environment and sustainability.

It is pertinent to note that, the sector is dominated by foreign firms in major developing countries like Ghana and Nigeria. Nguyen et al. (2009) suggest the need to consider the traditional procurement approach. Rwelamila and Savile (1994) states that construction projects do not occur in isolation but are influenced by country, location, project type and the procurement systems as it relates to stakeholder management. Moreover, the selection of most appropriate construction procurement system impact on managing the many stakeholders (Rwelamila, 2010). There several construction stakeholders involved in a project with diverse

socio-cultural background impacts on the project delivery (Mok et al., 2015). Most developing countries continue to adopt the separated (traditional) approach (PPA 2003, Act 663; Oyedele, 2013).

2.3 Stakeholder Management Theory

Construction projects are unique bringing together different and disparate interests (Olander and Landin, 2005). Researchers have defined and classified project stakeholders differently following the first introduction of stakeholder concept into the management domain by the Stanford Research Institute in 1963. Stakeholders were defined as any groups or individuals who are crucial for an organization's survival and can affect or are affected by the achievement of the firm's objectives (Freeman, 1984). Gibson (2000) defines stakeholders as "groups or individuals with vested interest in the success of a project or environment, which the organisation interacts or has interdependencies". They are further defined as "those that by virtue of their interaction with an organisation may initiate or trigger a project if perceived to be beneficial or antagonistic, disrupt, and stop an ongoing project if perceived not" (Mintzberg et al., 1995; Newcombe, 2003).

Chinyio and Olomolaiye (2010) states that construction stakeholders are many and should manage the many stakeholders including the owners, project manager, users, facility managers, designers, contractors, subcontractors, employees, process and service providers, banks, insurance companies, media, general public, community representatives, customers, pressure groups. Newcombe (2003) have suggested that project managers have always considered the client as the only project stakeholder a trend which needs to change. PMI (2013) suggests that meeting all stakeholders need and satisfaction is an important project success factor. Stakeholder theory has evolved out of the need to consider all stakeholders. Researchers have attributed the fame of stakeholder theory and literature in management domain to the book, *Strategic Management: Stakeholder Management Approach* by Edward Freeman in 1984 (Yang, 2010; Freeman and Mc Vea, 2001). It is pertinent to note that stakeholder theory has gained popularity in the past three decades, focusing on different perspectives on how managers of organizations should manage their stakeholders. Gibson (2000) states that stakeholder theory in contrast with traditional theories asserts that, the interest of individuals and groups affected by an organization's activities should be considered. Elias et al. (2002) state that four areas namely corporate strategy, systems theory, organizational theory and corporate social responsibilities developed out of the management approach.

- Corporate strategy: literature suggests that Ansoff (1965) argued for rejection of the stakeholder theory in his classic book *Corporate Strategy* since it considered objectives and responsibilities as synonyms. This was part of the fight for the survival of stakeholder theory. Strategic planning literature began to feature prominently stakeholder theory in the late 1970's. Taylor (1971) predicted that the importance of stakeholders will diminish because businesses were going to run for other stakeholders.
- Systems theory: this nevertheless contributed to the development of stakeholder theory. Ackoff (1974) argued for stakeholder participation in system design importance of when he suggested that stakeholder interaction and support helps in solving societal issues.
- Corporate social responsibility: many researchers became concerned with corporate social responsibility CSR, as management literature featured stakeholder concept. Post (1981) covered areas such as ideas, concepts and techniques of earlier researchers and included non-traditional stakeholders in literature using as a primary difference stakeholder theory concept.

- Organizational theory: Rhenman (1968), referred stakeholders as individuals and groups which depend on an organization for survival and the vice versa. Pfeffer and Salancik also suggested the effectiveness of an organization as determined by the ability to manage the demands of interest group using a model of organization and environment. Classic stakeholder theory evolved on the basis of survival and diverged into the four areas considered (Freeman, 1984).

Donaldson and Preston (1995) argue that the stakeholder concept is about management, Freeman *et al.*, (2004) suggest it is prescriptive, descriptive, suggestive and instrumental at the same time. Mitchell et al., (1997) states that stakeholder management is embedded in management thinking and practice since Freeman 1984 and that there is no agreement on what Freeman (1984) calls "The Principle of Who or What Really Counts." That is, who (or what) are the firm's stakeholders? This question calls for a normative theory of stakeholder identification, to explain logically why managers should consider certain classes of entities as stakeholders. The second question "And to whom (or what) do managers pay attention? calls for a descriptive theory of stakeholder salience.

Gibson (2000) mentions Donaldson and Preston (1995) as having distinguished between the descriptive, instrumental and normative approaches to stakeholder theory. The descriptive approach examines stakeholder interests, the instrumental approach stakeholder impact in terms of corporate effectiveness while the normative approach reasons why corporations ought to consider stakeholder interests even in the absence of any apparent benefit suggesting the need to consider all project stakeholders. Several research has followed in the three aspects of descriptive, instrumental and normative (Yang, 2010). The stakeholder concept seems to address the questions, who are the project stakeholders? And what do these stakeholders expect from a construction project? (Newcombe, 2003). The question remaining is "how do project managers manage these stakeholder clients?" As stakeholder theory in contrast with traditional theories asserts that interest of groups and individuals affected as a result of an organisation's activities construction project managers consider only the interest of the client as a single entity in the traditional approach (Friedman, 1970; Newcombe, 2003). The UK and Finland stakeholder management addressing the third question are reviewed (Oyegoke, 2010; Thompson, 2010).

Construction stakeholders are classified severally depending on their relationship and contractual agreement. Carroll and Buchholtz (2006) mentions primary; with a formal agreement with the project owner and secondary if not. Primary stakeholders are critical to project delivery (Clarkson, 1995) but could be without strong influence due to buyer dominance (Walker, 2007). Chinyio and Olomolaiye (2010) agree that some stakeholders are critical to the project success though others may change position as the project progresses. The trend then is to monitor stakeholders during the project development stage. Further, stakeholders are referred as internal (key stakeholders) or external to the project (OGC, 2003; Calvert 1995; Winch and Bonke, 2002), Mitchel et al., (1997) however suggest that stakeholder classification should be based on salience to a project considering power, urgency, and legitimacy. Stakeholders are classified as dormant, discretionary, demanding, dominant, dangerous or definitive. Key stakeholders are thus, primary, internal and definitive stakeholders and refer to the project team: client, project manager, main designer, other designers, contractor, sponsors and consumers/end users.

2.4 Stakeholder Management Process

Jergeas et al. (2000) stress the need for efficient management of the relationships between the project and its stakeholders as an important key to project success. Bourne and Walker (2005) states that Stakeholder Management (SM) is an effective approach of bringing stakeholder

concerns to the surface and developing robust stakeholder relationships in complex project environments. Young (2006) agrees and suggests that SM should include identifying, gathering information and analysing stakeholders influence through a systematic approach (Lock, 2007). Eskerod and Jepsen (2013) suggest identification, assessment of contribution, stakeholder prioritization and analyses. Challenges to project managers are identification of diverse stakeholders and the best approach to stakeholder management for effective impact on project delivery (Chinyio and Akintoye, 2008; Mok et al., 2015). Yang (2010) has outlined a chronology of stakeholder management models, processes and approaches to include; Stakeholder Matrix (Chinyio and Olomolaiye, 2010; Newcombe, 1996), Stakeholder Circle Tool (Bourne, 2005), Social Network Analysis (Bourne and Walker, 2005; Rowley, 1997) and stakeholder management framework for developed countries. Research has shown that project managers in Ghana a developing country considers only some aspects of SM keeps mental record instead of documentation and without a formal process (Eyiah-Botwe, 2015). This contradicts a current trend in project development where stakeholder management process involves a high level of the pre-project planning effort, can save up to 20% from cost and 39% of scheduled in facilities projects if considered (Cho and Gibson, 2001).

2.4.1 Historical development of stakeholder management in the UK

Harris (2010) presents the chronology of stakeholder management in the UK which evolved as a result of the construction industry development which was stakeholder focused as follows:

- Early reports- placing and management of contracts, problems before the construction industry, communication, interdependence and uncertainty (stakeholder issues)
- Latham 1 (1993) - mistrust between client's consultants, contractors, subcontractors and client dissatisfactions.
- Latham 2 (1994) - the potential for productivity improvements through better procurement practices notably teamwork.
- Levene (1995) - procurement and management improvement to include better communication and negotiation of deals
- Egan 1 (1998) - inefficiency, unpredictability and customer dissatisfaction. Call for best practice and innovation to result in increased delivery, reduction in project completion times.
- Egan 2 (2002) - a collaboration between members of the supply team, advocate or design and build. For all aspects of the project, partners and stakeholder are crucial.
- National Audit Office (2003-2005) - adversarial relationships, benefits of partnering, modernising construction, adoption of PFI, PPP, Prime contractor Design and Build.
- DCLG (2007) - Greater strategic leadership, more integrated and innovative solutions.

2.4.2 Historical development of stakeholder management in Finland

Oyegoke (2006) suggest that the Finland approach could serve as a subsequent transferable learning opportunity for stakeholder management development. Barrie and Paulson (1992) identified the building industry as custom-oriented, incentive dependent and predicted human factors leading to the fragmented and divisible industry. There is stakeholder management concern of ageing workers, declined the number of skilled domestic labour, challenging combination of product development and value chain production management. SM process in Finland is carried out by evaluating the needs and expectations of stakeholders in relation to project objectives and designing project management process which enables active stakeholder interaction throughout project life cycle. Key management principles to be considered at various stages are:

- Identification- early identification of stakeholder commences as the project is conceived, need to consider legitimacy, power and urgency of stakeholders (Mitchelle et al., 1997).
- Programming- overall guidelines and principles formulated, the management of stakeholders is agreed upon through the form of procurement.
- Appraisal- assessment of key project factors from key stakeholders' viewpoint.
- Implementation- bringing together a different group of professionals in the supply chain and facility management. Client's influence is brought to bear. The Specialist Task organization (STO) approach that allows for upper and lower management through integrated product development. External stakeholders are monitored, and communication enhanced.
- Facility management- this phase is crucial and should be included in the overall stakeholder.

In conclusion, Oyegoke (2006) suggests that stakeholder management is essential in achieving objectives in a project and that project stakes could be through legal or moral rights, Stakeholder management approach is determined by the procurement approach, integrated approach is recommended as project managers carry out all the principles at the different phases.

3 Methodology

This study adopted an exploratory survey approach using a qualitative technique involving a literature review primarily. The research design first considered an extensive literature review on stakeholder management using the institutional database to search for recommended journals by the institution as this study forms part of a broader study of a Ph.D. dissertation. Journals were searched using keywords such as “stakeholder”, “stakeholder management” and “construction industry”. This was further filtered using a combination of the keywords “construction industry” and “stakeholder management” to narrow the scope of limited literature. This method has been used by Yang et al., (2010) and Mok et al., (2015) for similar studies in stakeholder management. Fifty journals were in all identified and thoroughly reviewed. Three books from Google scholar and different publishers recognized to have well-researched information on stakeholder and construction stakeholder management were examined.

The research further reviewed the UK and Finland SM processes as a case study since their SM process are considered among the best practices in the industry, availability of historical development data and providing best perspective on the theme (Chnyio and Olomolaiye, 2010). Reports and Acts aimed at enhancing stakeholder management approach in the construction industry in Ghana were also reviewed. The literature review sought to find out the impact of the following on historical development of SM:

- historical development of projects, the construction industry and stakeholder theory
- the role of professional and statutory bodies in developing SM
- the role of procurement systems on SM development and
- the process of engaging, monitoring and managing stakeholders in the construction industry

A qualitative approach using semi-structured questionnaire was used to interview four experienced construction industry practitioners in Ghana in order to validate literature reviewed. For the purpose of ethics, they are represented as IA, IB, IC and ID respectively.

Table 1. Interviewees' profile

Interviewee	Profession	Experience	Relevance
IA	Architect, Project Manager	Over 40yrs	Lecturer, Chapter President Ghana Institute of Architects
IB	Architect, Project Manager	Over 15yrs	Architect, Deputy Director, Ministry of Works and Housing
IC	Quantity Surveyor, Project Manager	Over 30yrs	Surveyor, Moderator, Past President, GHIS
ID	Structural Engineer, Project Manager	Over 40yrs	Past President, Ghana Institution of Engineers

4 Findings and Analysis

Although Stakeholder Management (SM) has been in management domain since 1984, the last two decades has seen increased research and development of several approaches. SM has evolved and developed as a result of formal construction industry challenges and reviews aimed at enhancing stakeholder role and project delivery. Developed nations construction industries have embraced stakeholder involvement and participation for improved construction industry performance different SM processes and a framework for SM in development (Yang, 2010). Nevertheless, countries like the UK, Australia and Finland have developed frameworks for their construction sector (Haris 2010, Chinyio and Akintoye, 2008). Professional and statutory bodies have played a significant role in the development SM in developed countries. The setting up of construction industry regulating bodies (cidb) in South Africa has enhanced project stakeholder management.

The study also found out that procurement methods have influenced stakeholder role and participation in project delivery and the current trend of adopting integrated and management contracts as against separated contracts (Rwelamila, 2010). Different forms of contract which are stakeholder focused have emerged, promoting active stakeholder involvement, more successful project delivery, enhanced stakeholder satisfaction, appropriate contractual arrangements for stakeholder management. The five-stage project planning approach in Finland is stakeholder focus. Verification of needs stage suggests the need to identify all stakeholders and the project sponsor or client. A project manager (PM) is appointed to lead the assessment of options stage. The PM and the client plays an essential role in the development of procurement strategy. This planning phase is ended by choosing the appropriate strategy. The stakeholder management approach is influenced by role and identification of stakeholders, the selection of the right project manager, and choice of appropriate procurement strategy, integrated and innovative solutions. Projects cannot be successfully delivered without a systematic approach to SM, which includes project stakeholder identification, classification, analyzing and monitoring. A pre-condition of embracement of SM by industry practitioners, culture and environment related to the industry is critical (Yang, 2010).

The interviewees agreed with the literature findings but bemoaned the poor project delivery and attributed that to the nature of the construction industry practices in Ghana. IA asked *“have you read, the Performance Audit Report 2013, all that we need is a framework for project managers”* to use in monitoring stakeholders. Similarly, IB suggested the need for collaboration and a formal approach to project management. *“There is too much lack of trust affecting decisions”*. IC primary concern was the procurement approach adopted. *“This approach requires too much time, the late involvement of some key stakeholders. How do you manage your targets?”* ID had two main concerns; the need for the construction industry regulated and incorporated lesson on previous projects in new ones. *“We seem to be doing new things every day, there is no documentation anywhere to learn from.* In his opinion, the industry

is fragmented with each sub-sector trying to develop separate approach instead of one stakeholder management plan. These responses agree with earlier studies (Eskerod and Jepsen, 2013; Chinyio and Olomolaiye, 2010).

4.1 Historical development of stakeholder management in Ghana

The study found out that, projects cannot be successfully developed in Ghana without SM consideration by project managers. Project success is critical due to the importance of the construction industry in the socio-economic growth of Ghana (Ofori, 2013; Fugar, et al., (2013). Historical development towards stakeholder management was then identified and documented as follows:

- Architects Act, 1969(NLCD 357) – regulate practices and operations of architects as project designers, project leaders/ managers to successfully manage the project team.
- Local government act, 1993 act 462, the Town and Country Planning Department was charged with the overall planning and development control within its jurisdiction.
- Building Regulation, 1996 (LI 1630)- Outlines, regulations and bye-laws for development.
- Local Government Act1993 (Act 467) – Metropolitan, Municipal and District Assemblies together with the planning authorities regulate physical development. This should conform to building codes and established the statutory approval bodies to include all stakeholders.
- Ghana vision 2020 (1995)- using resources efficiently to achieve rapid economic growth with emphasis on using local materials and sustainable principles not on managing projects.
- GETFund Act, 2000 (Act 581) – improved education infrastructure
- Public Procurement Act of Ghana, Act 663(2003) aimed at sanitizing the industry, regulating procurement process and encouraging competitive tendering however not aimed at collaboration or integration but separated approach.
- February 2010 – 1st GETFund Consultative meeting – engage all stakeholders for enhanced infrastructure delivery.
- Engineering Council Act, 2011(Act 819) – regulate practices and operations of architects as project designers, project leaders/ managers to successfully manage the project team.
- National Urban Policy Framework and Action (2012)- the participation of all relevant stakeholders to ensure better transparency and accountability, zonal stakeholders consultation workshops to review and validate action plan
- National Housing Policy (2015) – Ensure that there is the participation of all stakeholders in decision-making on housing projects. Involve communities and non-traditional interest groups.
- Proposed Construction Industry Development Authority Bill, 2015. Provide strategic leadership in the construction industry to stimulate sustainable growth, reform, improve and monitor standards in the construction industry (Ofori et al., 2015).

5 Conclusions

This study sought out to review the literature on the historical development of SM and document historical development in Ghana as part of a broader study aimed at developing sustainable SM framework for construction projects in Ghana. Firstly, it identified the construction industry challenges, poor project delivery and procurement approach as having

influenced SM approach. This was enhanced by the formal documentation of the historical development of the industry and embracing SM process. Secondary, the study recognized the impact of procurement approach SM hence the need for stakeholder involvement, collaborative or integrated approaches with early identification and participation of stakeholders in project delivery. The construction industry has had a strong monitoring body to review performance. Thirdly the study aimed at identifying and documenting the historical development of SM in Ghana. This has been documented as a contribution to the body of knowledge in SM. The construction industry has challenges, promotes separated procurement approach, and lacks a body to oversee the performance and a framework for SM approach. The gap was the absence of a historical documentation of SM serving as a basis for the development of a sustainable stakeholder management framework.

6 References

- Beach, S (2009). Who or what decides how stakeholders are optimally engaged by governance networks delivering public outcomes? In: *13th International Research Society for Public Management Conference (IRSPM XIII)*, 6–8 April 2009, Copen. Bus. Sch, Fredericksberg.
- Bourne, L (2005). *Project Relationship Management and the Stakeholder Circle*, Graduate School of Business, RMIT University, Melbourne.
- Bourne, L. and Walker, D (2005). Visualising and mapping stakeholder influence, *Management Decision*, Vol. 43 No. 5, pp. 649-660.
- Chinyio, E. A. and Akintoye, A (2008). Practical approaches for engaging stakeholders: finding from the UK, *Construction Management and Economics*, Vol. 26 No. 6, pp. 591-599.
- Chinyio, E. and Olomolaiye, P (2010). *Construction Stakeholder Management*, Chichester Wiley. Blackwell Publishing Ltd.
- Donaldson, T and Preston, L. E (1995). The stakeholder theory of corporation: concepts, evidence and implication. *Academy of management review*, 20(1):65-91.
- Elias, A, A, Cavana, R, Y, and Jackson L, S. (2002). *Stakeholder analysis for R&D project management*, Oxford Blackwell Publishers Ltd,
- Egan, Sir J. (1998). *Rethinking Construction*. Department of the Environment, London.
- Eyiah-Botwe, E. (2015). An evaluation of stakeholder management role in getfund polytechnic projects delivery in Ghana: *Journal of Civil and Environmental Research*, Vol 7, No. 3, 2015
- Freeman, R.E. (1984). *Strategic Management: a Stakeholder Approach*, Pitman Publishing, Boston, MA.
- Gardiner, P,D (2005). *Project Management-A Strategic Planning Approach*. New York,USA: Palgrave Macmillan.
- Gibson, K (2000). The moral basis of stakeholder theory. *Journal of Business Ethics*, 26(3):245-
- Harris, F (2010). A Historical Overview of Stakeholder Management. In: Chinyio and Olomolaiye, *Construction Stakeholder Management*, Chichester Wiley. Blackwell Pub. Ltd.
- Jergeas, G.F, Erin, W, Gregory, J. S and Janice, T (2000). *Stakeholder management on construction projects*. AACE International Transaction, Morgantown, WV, 12.11–12.16.
- Jurgens, M, Berthon, P, Papania, L and Shabbir, A (2010). *Industrial Marketing Management* 39 (2010) 769–77
- Mitchell, R, Agle, B. and Wood, D (1997). Towards a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Academy of Management Review*, 22, (4) 853–886

- Mok, K. Y.; Shen, G. Q.; Yang, J. (2013), Stakeholder management studies in mega construction projects: A review and future directions. *International Journal of Project Management*.
- Newcombe, R (2003). From client to project stakeholders: A stakeholder mapping approach. *Construction Management and Economics*, 21(8) 841-848.
- Ofori, G. (2000). Challenges for construction industries in developing countries. Proceedings of the Second International Conference of the CIB TG 29, Gaborone, Botswana, Nov, pp. 1–11
- Ofori, G. (2012), Developing the Construction Industry in Ghana: the case for a central agency.
- Olander, S. and Landin, A(2005). Evaluation of stakeholder influence in the implementation of construction projects. *International Journal of Project Management* 23.
- Othman, A. (2013), Challenges of mega construction projects in developing countries. *Organisation, Technology and Management*. in *Cons. An International Journal*
- Oyedele, O. A. (2013), *Construction Project Financing for Sustainable Development of Nigeria Cities*. FIG Working Week, 2013, Abuja Nigeria.
- Oyegoke, A. S, (2010). The Contextual Approach to Stakeholder Management in Finland. In: Chinyio and Olomolaiye, *Construction Stakeholder Management*, Chichester Wiley. Blackwell Publication. Ltd
- PMI (2013), *A Guide to the Project Management Body of Knowledge: (PMBOK guide)*. Project Management Institute, Newtown Square, PA. 5th ed.
- Rwelamila, P. D (2010). Impact of Procurement on Stakeholder Management. In: Chinyio and Olomolaiye, *Construction Stakeholder Management*, Chichester Wiley. Blackwell Publication. Ltd
- Rwelamila, P. D and Savile, P W (1994). Hybrid value engineering:the challenge of construction project management in the 1990s. *International Journal of project Management*, 12(3):157-164
- Yang, J (2010). A framework for stakeholder management in construction projects: A thesis submitted in partial fulfillment of the Degree of Doctor of Philosophy.
<http://www.lib.polyu.edu.hk>

BUILDING INFORMATION MODELING IN NIGERIA AND ITS IMPACT ON COLLABORATION IN SCHEMATIC DESIGN STAGE AND POST CONTRACT STAGE OF DESIGN

Onungwa, Ihuoma Onyinyechi; Uduma-Olugu, Nnezi

Department of Architecture, School of Environmental Science, University of Lagos, Lagos, Nigeria

Abstract

Building Information Modeling (BIM) is a concept that is transforming the construction world internationally. As Nigeria develops technologically, the use of BIM in design and implementation of projects is also developing. BIM is used to develop a collaborative construction process that includes design, build, operate and maintenance of buildings. However the adoption of BIM in Nigeria is very slow; it is used mostly for schematic design and presentation drawings by Architects. Other professionals in the construction industry still produce their drawings with 2D AutoCAD. The purpose of this paper is to study the use of BIM in Nigeria and determine to what extent it has helped in improving efficiency and collaboration during schematic phase of design and provided effective co-ordination during the post contract stage. The research methodology involved using structured questionnaires to 30 Architectural firms selected through simple random sampling method. Results showed BIM has a high impact on client satisfaction, time for completion, quality and presentation of different concepts in schematic design. It also showed high impact on conflict resolution, supervision, construction programming and quality of completed jobs during post contract stage. Barriers to adoption of BIM were identified as lack of infrastructure, lack of skilled workers and lack of awareness of technology. For Nigeria to compete internationally in the construction industry, BIM should be adopted hence there is need for research on the subject. Recommendations include developing a curriculum that will incorporate the study of BIM in all construction courses. Learning centres should also be developed for private practitioners. Efforts should be made by the relevant professional bodies to increase awareness of the technology.

Keywords: Adoption, Building Information Modeling, Nigeria

1 Introduction

Building Information Modeling (BIM) is the use of computer generated models to simulate planning, design and construction of projects. According to Autodesk (1999), “Building information modeling is a design methodology that maintains a single database of information about a building design. All information for a building design, from geometry to construction data is stored in a project file. This information includes components used to design the model, views of the project, drawings of the design and related documentation”.

Internationally, the building industry is transforming rapidly with the introduction of BIM. It is changing the process of design and construction of buildings. “BIM entails a seven dimensional process. The 3D modeling process extends to scheduling and sequencing (4D), cost estimating (5D), sustainable design also termed Green Design (6D) and facility management (7D)” (Hassan and Yolles, (2009).

BIM is a new approach to design depending on collaboration between the Architects, Client, Engineers, Building services, Manufacturers, Contractors and other consultants. It is a team approach where inputs of all the professionals in the design are captured in the same model. The most common softwares for BIM are Autodesk Revit, Microstation, ArchiCad, CBIM and Ruska.

1.1 Problem Statement

Building Information Modeling programs are being adopted by Architectural Firms in Nigeria. However, they are mostly used for sketch and presentation designs. Collaboration and improvement in communication and efficiency during construction is one of the major advantages of Building Information Modeling. It is also one of the major problems in the Nigerian construction industry. This research seeks to find out the challenges and barriers to adoption of Building information modeling in Nigeria, Factors impending adoption of building information modeling and provide solutions to these challenges.

1.2 Aims and Objectives

The purpose of this Research is to study the use of Building Information Modeling in Nigeria and determine to what extent it has helped in improving efficiency and collaboration during schematic phase of design and provided effective co-ordination during the post contract stage. The results will be measured according to primary key performance indicators used in construction industry. These include quality, on-time completion, safety, client/customer relationship, communication between consultants and other stake holders in the project.

Objectives of the research include:

1. To investigate if BIM use improves efficiency and collaboration during schematic design phase.
2. To determine the impact of BIM on supervision and co-ordination during the post contract stage of design.
3. To determine barriers to the full adoption of BIM in Lagos, Nigeria.
4. To identify solutions to challenges and barriers

2 Analysis of Literature Review

A lot of literature is available on Building Information Modeling (BIM). However, Literature on BIM in Nigeria is limited. “BIM can potentially increase the efficiency, quality and productivity of construction projects by reducing the number of mistakes and incompatibilities, providing more accurate and up-to date information, and by giving a more illustrative and accessible exposition of a building, (Eastman et al. 2011). Benefits of BIM include the ability to reuse information stored in a database, (Egbu and Sidawi, 2012). Automation through BIM also improves time and cost management. It streamlines the design process across the company and facilitates automation of emails via knowledge database.

Other benefits include ability to visualize what is to be built in a simulated environment, higher reliability of expected field conditions, allowing for opportunity to do more prefabrication of materials off site (Rajedran and Clarke, 2011). According to Gordon and Holness (2008), “The building design development can continue with the provision of automatic bills of material and generation of automatic shop drawings for everything from structural steel to sheet metal duct fabrication, to fire protection and piping fabrication, to electrical cabling and bus duct layouts”.

Benefits of ‘GIS-BIM’ based site analysis (CICRP, 2009) include aid in determining if potential sites meet the required criteria according to project requirements and minimizing risk of hazardous materials. “The advances in smartphone and tablets technology have allowed contractors and subcontractors to frequently use BIM models at the jobsite for information

extraction and coordination. Some of the notable BIM apps include BIMX®, Bentley Navigator®, Buzzsaw®,” (Rubenstone, 2012).

2.1 Challenges to BIM Adoption in Nigeria

Challenges to BIM Adoption in Nigeria include interoperability risks between different programs used (Azhar et al., 2011). A lot of Architects and Engineers still use 2D AutoCAD in Nigeria. This affects collaboration of construction working drawings and limits use of BIM during post contract stage. A survey by AECbytes shows that despite each discipline working in 3D environment, collaboration is still primarily based on exchange of 2D drawings. (Khemlani, 2007).

Furthermore, the ownership of BIM data has not yet been determined. It is not yet clear if the BIM belongs to the client who paid for it to be done or the Architect who developed the model. This can create conflict if the client decides to get inputs from other consultants by himself. Most times the Architect has to bear the cost of changes in the model during construction as the client is not willing to pay for extra costs. This increases the cost of production for Architects. Most BIM in use do not have object libraries that are used in the Nigerian Market. Standards for drawing presentation have not been developed. Integrated concept of BIM increases risk and liabilities to different parties involved (Azhar et al., 2011). This creates problems when vendors and other consultants make input to the BIM. BIM systems create big files, management and transfer of these files with Nigerian internet and power problems is very difficult.

2.2 Barriers to adoption of BIM in Nigeria

Barriers to BIM adoption include lack of skilled personnel. There are not enough trained personnel in the industry. Most Architects train themselves or learn on the Job so they are not aware of all the capabilities of the software. Reluctance of other stake holders (Engineers, Contractors, etc.) to use BIM makes it difficult for Architects who are using BIM because they have to transfer their drawings to AutoCAD for the other consultants to do their work.

“Fear of change” is another barrier to adoption of BIM (Hassan and Yolles, 2009). Most people are very comfortable with the software they are using and find it very difficult to change. Using BIM means a change of mindset from developing drawings with lines to developing drawings in three dimensions putting in walls, windows, doors and other building components. Extra costs involved in hardware, software and developing office procedures are also barriers to adoption. Adopting BIM involves, purchasing of software and hardware that can be used. It involves training of staff already working in the office. This will lead to extra costs for the office.

According to Farley (2011), “lack of BIM object libraries” affects production of drawings because some products are not available in the software. , Lack of constant electricity and lack of internet connectivity affects output of work in the offices. (Abubakir et al., 2014). Constant use of generators increases cost of running the offices. Internet connection is necessary for BIM to be used adequately. Internet has to be connected to get drawings from a vendor site. Internet is not readily available in Nigeria Use of internet also increases cost of production. A lot of professionals in the construction industry are still not aware of the technology. For BIM to be used effectively, all the professionals involved in a project have to be aware of it.

2.3 Solutions to Challenges and barriers

The need to incorporate BIM education in our Universities is emphasized. One of the aims of this research is to establish an Autodesk authorized training centre in University of Lagos that will be used for training of Architects and other professionals in the construction industry. Building information modeling as a course should be introduced in all schools of Architecture

Engineering, quantity surveying and other construction disciplines. We need to create awareness within the professional bodies. Nigerian institute of Architects, Nigerian institute of quantity surveyors and other regulatory bodies in the construction industry need to get involved with Building Information Modeling and help in standardization of BIM in Nigeria.

The Government has to be involved. Most of the countries that have successfully adopted BIM have government participation. "Government has helped to achieve progress in most countries. The General Services Administration (GSA) in the U.S.A made the use of BIM a requirement on all major projects receiving significant public funding in 2007. In Finland, the Senate Properties, a government owned organization implemented BIM Requirements in October 2007. Such a role has been played by governments in Northern Europe. In Singapore, the CORENET e-PLAN Check system (Construction Real Estate NETWORK), launched by Singapore's Ministry of National Development) provides automated compliance checking against building codes for schemes designed using BIM." (Alufohai, A, 2012). Federal government of Nigeria and other building and construction agencies should enforce the use of BIM by organizing workshops and seminars to educate owners, Architects, Engineers, Contractors and other stakeholders on the uses and advantages of BIM for public and private construction projects in Nigeria. To improve the industry and make us more competitive in the World, there is need for more research on the use of Building Information Modeling in Construction in Nigeria.

3 Research Methodology

The Research was conducted with a structured questionnaire as a tool of data collection distributed to 30 Architectural firms. The questionnaire was divided into 4 parts. The first part gathered general information about the Architectural firm: Company Name, Address, Years in Business, Total No of Employees, kind of projects and software used for drawings. The second part of the questionnaire gathered data on the impact of BIM in schematic design using. The third part of the questionnaire gathered data on impact of BIM on post-contract design stage while the fourth part obtained information on the company's perception of barriers to the adoption of BIM in Nigeria. The factors identified through literature were used as variables for 3 tables on second, third and fourth part of the questionnaire.

Variables for impact on Schematic design were: collaboration with other consultants, client satisfaction, time of completion, quality of drawings, collaboration with other staff in the office, presentation of different design concepts. Variables for impact on post contract stage were: collaboration with other consultants, construction programming, estimation of costs, supervision of jobs, quality of completed project, time of completion, energy efficiency, safety, and conflict resolution. Factors affecting adoption of BIM were barriers to adoption listed in the literature review. Questionnaires were given to 30 companies randomly selected from list of Architectural firms by the Nigerian institute of Architects. The responses obtained were used to draw inferences. The firms were also asked to state their own contributions on the effect of BIM on sketch design and post contract design stage.

4 Findings and Discussion

4.1 Reliability Analysis of Questionnaire on Impact of Building Information Modelling (BIM) on Collaboration in Schematic Design and Post Contract Design Stage

Table 1. Reliability test results of instrument

Instrument	Scale Statistics					Reliability Statistics	Validity Statistics (ANOVA)	
	No. of Items	N of Samples	Mean	SD	CV		F-value	P-value
Source						Cronbach's Alpha		
Impact of BIM on Schematic Design Stage	6	16	26.81	2.040	0.08	0.737	140.904	0.000
Impact of BIM on Post Contract Design Stage	9	16	38.31	3.610	0.09	0.767	22.735	0.000
Factors Preventing Adoption	9	16	32.19	4.722	0.15	0.760	32.626	0.000

Key: SD (Standard Deviation); CV (Coefficient of Variation)

(Source: Field survey, 2015)

The test of reliability of the responses on study of Impact of Building Information Modeling (BIM) on Collaboration in Schematic Design and Post Contract Design Stage, using standardized Cronbach's Alpha is obtained for each section as 0.737 (73.7%), 0.767 (76.7%) and 0.760 (76.0%). These results suggest that the instrument of evaluation is highly reliable judging from the fact that 73.7%, 76.7% and 76.0%. > 70% threshold value, respectively. Further, the results implied that there is an internal consistency of the items in the instruments (questionnaires) used for data collection. These results are supported by the coefficient of variation (CV) values; 0.08, 0.09 and 0.15, which are respectively less than 0.50 threshold value, indicating homogeneity on how the respondents rated the items. Hence, there is an internal consistency of the answers from the respondents and therefore the data do not violate the assumption of reliability. The construct validation of the reliability results of instruments is carried out using analysis of variance (ANOVA) to test if there is no significance variation on how the respondents rated the items in each section of the instrument. The result of the analysis reveals that the test is significant at F-value = 140.904, 22.735 and 32.626, $P < 0.05$, respectively. The results suggest that there is no significance variation on the rating of the items by respondents in the instruments. Hence, the reliability of the instruments is significant, which validates the adequacy of the instruments.

Table 2. Analysis of socio-economic variables

Variable	Characteristics	Freq.	%	Mean	Total
Address	Within Lagos	12	75.0		
	Other South West	3	18.8		
	South South	1	6.3		16
Years in Business	1-5 years	5	31.3		
	6-10 years	2	12.5		
	11–15years	6	37.5		
	Over 21 years	3	18.8	10.8yrs	16
Total No of Employees	1-5 staff	8	50.0		
	6-10 staff	6	37.5		
	11–15 staff	1	6.3		
	Over 21 staff	1	6.3	7 staff	16
What kind of projects do you do?	mostly residential	1	6.3		
	mostly Commercial	1	6.3		
	all Building Types	14	87.5		16
Do you use any Building information modeling software in your practice?	Yes	16	100.0		16
If yes, which software do you use?	AutoCAD Revit	13	81.3		
	ArchiCad	3	18.7		16
If No, are you considering adopting BIM in the future?	No	15	93.8		
	Yes	1	6.3		16
Would you consider an applicant using BIM for employment before one that does not use it?	No	2	12.5		
	Yes	14	87.5		16

(Source: Field survey, 2015)

81.3% of the Architects interviewed use AutoCAD Revit in their office while 18.7% use ArchiCAD. 37.5% of the Architects interviewed have been in practice for 11 to 15 years while 18.8% have been in practice for over 21 years. 56.3% of the firms have been in practice for more than 10 years. The architects who are not using BIM stated that they will consider Architects using BIM for employment before those not using it. This means that they consider BIM to be an important skill.

Research Question 1: How has the use of BIM solutions improved your drawings during schematic design stage?

Table 3. Analysis of impact of BIM on schematic design stage

Variables	Response					Descriptive			
	1	2	3	4	5	Mean	Rank	Relative Index	Extent
Client satisfaction	-	-	-	5	11	4.69	1	1.05	High
Quality of drawings produced	-	-	-	5	11	4.69	1	1.05	High
Time of completion of presentation drawings	-	-	1	6	9	4.50	2	1.01	High
Presentation of different concepts of design	-	1	1	3	11	4.50	2	1.01	High
Collaboration with other staff in your office	-	-	2	7	7	4.31	3	0.96	Low
Collaboration with other consultants	-	1	3	5	7	4.13	4	0.92	Low
Pooled						4.47		1.00	

Key: No effect (1), Worse (2), Negligible (3), Much (4), Very much (5)

(Source: Field survey, 2015)

From the results, client satisfaction, quality of drawings produced, time of completion of drawings and presentation of different design concepts were the main advantages of BIM on schematic design phase. Conflict resolution in drawings was the main advantage in post-contract stage of designing (Table 4). This reinforces the statement that BIM improves co-ordination and efficiency during the post contract design stage. The major factors preventing adoption of BIM were identified as lack of skilled personnel, lack of internet connectivity. Reluctance of other stakeholders, lack of awareness of technology and lack of BIM object libraries were also identified as factors preventing adoption. This confirms studies from literature reviewed.

Research Question 2: How has the use of BIM solutions improved your drawings during post contract design stage?

Table 4. Analysis of impact of BIM on post-contract design Stage

Variables	Response					Mean	Rank	Descriptive		
	1	2	3	4	5			Relative Index	Extent	
Conflict resolution in drawings	-	-	1	4	11	4.63	1	1.09	High	
Construction programming	-	-	2	7	7	4.31	2	1.01	High	
Supervision of Jobs	-	-	1	9	6	4.31	2	1.01	High	
Quality of completed jobs	-	-	2	7	7	4.31	2	1.01	High	
Energy efficiency	-	-	2	7	7	4.31	2	1.01	High	
Time of completion	-	-	2	8	6	4.25	3	1.00	High	
Collaboration with other consultants	-	1	3	5	7	4.13	4	0.97	Low	
Estimation of costs	1	-	1	9	5	4.06	5	0.95	Low	
Safety	-	-	4	8	4	4.00	6	0.94	Low	
Pooled						4.26		1.00		

Key: No effect (1), Worse (2), Negligible (3), Much (4), Very much (5)

(Source: Field survey, 2015)

Research Question 3: What premium would you place on these factors as the barriers to adoption of Building Information Modeling in Lagos, Nigeria?

Table 5. Analysis of factors preventing adoption of BIM

Variables	Response					Mean	Rank	Descriptive		
	1	2	3	4	5			Relative Index	Extent	
Lack of skilled personnel	-	-	6	8	2	3.75	1	1.05	High	
Lack of internet connectivity	2	-	2	8	4	3.75	1	1.05	High	
Reluctance of other stake holders to use BIM	-	2	5	5	4	3.69	2	1.03	High	
Lack of BIM object Libraries	-	2	4	7	3	3.69	2	1.03	High	
Lack of awareness of technology	1	2	3	5	5	3.69	2	1.03	High	
Extra costs involved in hardware, software and developing office procedures	-	3	4	6	3	3.56	3	0.99	Low	
Frequent power failures	2	2	2	8	2	3.38	4	0.94	Low	
Lack of contractual documents for BIM	1	3	3	7	2	3.38	4	0.94	Low	
Fear of change	-	4	6	3	3	3.31	5	0.92	Low	
Pooled						3.58		1.00		

Key: For no impact (1), for little critical impact (2), for fairly critical impact (3), critical impact (4), for extremely critical impact (5)

(Source: Field survey, 2015)

Research Question 4: What are solutions to the challenges and barriers encountered?

Table 6. Analysis of solutions to challenges and barriers to adoption of BIM

Items	Frequency	Percent	Cumulative Percent
None	10	62.5	62.5
Policy maker should promote the use through result of reserches done in the institute.	1	6.3	68.8
Schools should provide necessary equipment and enforce learning to all students.	1	6.3	75.0
Seminars, lectures, demonstrations on use of bim.	1	6.3	81.3
The provision of basic infrastructure that will promote the use of bim.	1	6.3	87.5
Training and awareness.	1	6.3	93.8
Trainings, adaption to changes.	1	6.3	100.0
Total	16	100.0	

5 Conclusion and Further Research

This research was conducted to find the barriers to adoption of BIM in Nigeria and the solution to barriers. The barriers with most impact were lack of skilled personnel, lack of internet connectivity, Reluctance of other stakeholders to adopt BIM and lack of awareness of technology. From the study, the identified solutions to challenges are: Policy makers should promote the use of BIM through result of researches done; Schools should provide necessary equipment and enforce learning to all students, Seminars, Lectures and Training on the use of BIM should be conducted to professionals in the field, Infrastructure that will promote the use of BIM should be put in place. This includes constant electricity and internet connectivity.

Further research will be done on standards of BIM in the country and provision of BIM object libraries. This research will benefit Architects, the Government, Engineers, Contractors and all companies involved in construction in Nigeria.

6 Acknowledgement

This paper is as a result of an on-going research in University of Lagos. We acknowledge Professor Amole, Professor Igwe, Dr Iweka and the faculty at the Architectural Department of University of Lagos for their contribution to this paper.

7 References

- Abubakir, M., Ibrahim, Y., Kado, D. and Bala, K (2014). Contractor's perception of factors affecting building information modeling in the Nigerian Construction Industry. *Computing in Civil Engineering*, ASCE 2014, pp167-178
- Alufohai, A. (2012). Adoption of building information modeling and Nigeria's quest for project cost management. In FIG Working Week 2012, Knowing to manage the territory, protect the environment, evaluate the cultural heritage, 6-10 May 2012, Rome, Italy,
- Azhar, S., Hein, M. and Sketo, B. (2008). Building information management Benefits, Risks and Challenges, Mcwhorter school of building science, Auburn University
- CICRP (2009). BIM Project Execution Planning Guid. The Computer Integrated Construction Research Group, The Pennsylvania State University, PA.

- Eastman, C., Teicholz, P., Sacks, R. and Liston, K. (2011). BIM handbook, a guide to building Information modeling for owners, managers, designers, engineer, and contractors”, JohnWiley and Sons, Inc., New Jersey
- Egbu, C. and Sidawi, B. (2012). Building information modeling (BIM) implementation and remote construction projects; issues, challenges, and critiques” ITcon, 47, pp 75- 85.
- Farley, A. (2011). Assessing the impacts of building information modeling. *The Building economist*, June 2011, pp 13-19.
- Gordon, V. and Holness, P. (2008). BIM Gaining momentum. ashrae.org, June 2008.pp 28-30
- Hassan, A. and Yolles, H. (2009) “Building Information modeling , A primer” Canadian consulting Engineer, June/July 2009, pp 42
- Khemlani, L: 2007, “Top Criteria for BIM Solutions, A survey conducted by AECbytes”<http://www.aecbytes.com/feature/2007/BIMSurveyReport.html>
- Rajedran, S. and Clarke, B, (2011). Building information modeling, Safety benefits and opportunities. *Professional Safety*, October 2011, www.asse.org, pp46
- Rubensone, J. (2012). Autodesk Steers Users Toward the Cloud With Expanded Subscription-basedServices. *Engineering News Record*, April 16, 2012

MANAGEMENT STYLE AND QUALITY OF MANAGEMENT DURING CONSTRUCTION INFLUENCES ON PROJECT DELIVERY TIME

Aiyetan, Ayodeji.Olatunji

Department of Construction Management and Quantity Surveying, Fac. of Engr., Built Env. and Sciences, Durban Univ. of Techn., Durban, KwaZulu-Natal, South Africa

Smallwood, John Julian; Shakantu, Winston

Department of Construction Management, Faculty of Engineering, the Built Environment, and IT, Nelson Mandela Metropolitan University, Port Elizabeth, Eastern Cape, South Africa

Abstract

Construction projects are becoming complex in nature, therefore control is fundamental requirement to avoid overruns of key performance parameters. The aim of the study is to identify influencing factors of management style and quality of management during construction on project delivery time with a view to mitigating their impact. A questionnaire survey was conducted among stakeholders in the Building Construction Industry to access influencing factors of management style and quality of management during construction. Finding relative to management style include that set time limits, specify goals people are to accomplish and require regular reporting on progress and for quality of management during construction are effectively coordinating resources, developing an appropriate organization structure to maintain workflow influences project delivery time. In most cases these tradesmen require supervision construction, which results in delay and attending, may drastically reduce delay on projects. Based on the finding of the study, ways to mitigate poor management style and quality of management during construction were suggested.

Keywords: Construction, Delivery time, Management, Quality, Style

1 Introduction

Construction involve a lot of tasks, which are executed by tradesmen. In most cases these tradesmen require supervision in order to deliver the work according to specification and quality. The extent of management of these tradesmen with respect to the level of supervision given and management style will determine the quality of product. Management style dictates the quality of quality of product as happy workers engenders commitment to work leading to high productivity and quality products. Generally, workers do not want to be coarse to work. There is a need to balance supervision with the management style being adopted to achieve the optimum level of production and quality. This study assesses influence of management style and quality of management during construction on the delivery of projects in South Africa.

2 Literature Review

2.1 Management style

Management style deals with the personal attributes possessed by the manager in managing an organisation. Managers operate within an organisation and manage the functions of an organisation. These attributes possessed by managers that enable them to succeed are called competency. Rees and Porter (2001) define competence as the skills or knowledge possessed by individuals that enables them to manage an organisation successfully. Smallwood (2006) states that competencies can be divided into two categories: threshold or surface, which are required to be minimally effective and differentiating or core, a yardstick for superior performers.

The threshold or surface competencies are:

- Knowledge – information regarding content, and
- Skills – the ability to perform a task.

According to Singh (2004), competences can predict performance. Goals need to be defined before actions are taken and performance measured. There are three types of goals, namely:

- Organisation-wide goals – these include objectives pertaining to future directions for large segments of the organisation population;
- Task-oriented goals – they are specific objectives assigned to an individual or small group of individuals, and
- Personal goals or level of aspirations – these are goals set by the individuals themselves.

Fryer (2004) points out that many kinds of leadership study have taken account of the leader's competence or ability, either in the limited sense of technical ability or the wider sense of competence to lead. For an effective and efficient management of human resources, both the technical ability and competence to lead must be employed and could be referred to as management style.

The technical ability concerns the laying down of the construction methods and the drawing up of the schedule of works. The competence to lead refers to the motivation and support given to workers.

Griffith and Watson (2004) identify three management styles. These are exemplified by the following types of leaders:

- Autocratic leaders: They give orders which they insist shall be obeyed; determine policies for the group without consulting it; give no detailed information about future plans but simply tell the group what immediate step it must take; give personal praise or criticism to each member on their own initiative and remain aloof from the group for the greater part of the time;
- Democratic leaders: They give orders only after consulting the group; see to it that policies are worked out with the acceptance of the group (this is critical for effective implementation); never ask people to do things without sketching out the long-term plans on which they are to work; make it clear that praise or blame is a matter for the group and participate in the group as a member, and
- Laissez-faire leaders: They do not lead, but leave the group entirely to itself and do not participate.

2.2 Factors influencing management style

The factors that influence management style are discussed below. These include:

2.2.1 Specific goals people are to achieve

Pheng and Chuan (2005) state that the defining of goals affects project performance positively. The overall goal of an activity must be set out for each individual. This will be the driving force for day-to-day achievement and overall accomplishment of the goal. Goal-setting can inspire and motivate sub-ordinates, especially if their achievement is linked to remuneration. It also provides an effective means of evaluation and control (Du Toit et al., 2007). Additionally, when staff participate in the decision-making process of the organisation, it creates a sense of belonging which leads to individuals paying greater attention to their jobs. These create an environment conducive for work, resulting in high productivity.

2.2.2 Organise the work situation

One of the factors influencing performance in construction projects is sequencing of work and the allocation of crew sizes. Rojas and Aramvareel (2003) are of the opinion that out-of-sequence scheduling of work may result in a loss of momentum (rhythm). Walker and Shen (2002) suggest that contractor-related factors such as poor site management and supervision are major causes of delays in project delivery. Lack of organisation creates a situation of confusion and chaos, a situation in which no meaningful progress can be made. A site that is well laid out, in which offices, storage, and work spaces are well defined, aids the smooth flow of work.

2.2.3 Set time-lines

For the achievement of targeted production, time limits should be set for each task to be carried out. A bricklayer has a certain number of bricks to lay per day, depending on the type of brick. A fitter has a certain number of tones / kilograms of steel to bend or cut for a day's wage, and this applies to all trades. Based on this analogy, time lines are set for the achievement of each activity in order to avoid delay as clear time-lines promote more efficient and goal-driven work.

2.2.4 Provide specific direction

Managers or site engineers are supposed to provide specific direction on what must be done and how it must be done. Bassioni et al. (2005) declare that one factor that enhances performance is the development of the organisation's mission, vision and values by a leader and communication of these attributes to the workforce. Pheng and Chuan (2005) conclude that thirteen factors affect project performance negatively, among which is the availability of information. When this is lacking errors may occur, which may lead to poor workmanship and repetition of work. When these situations occur, the project will suffer delays.

2.2.5 Conduct regular updates on progress

Edum-Fotwe and McCaffer (2000) identify management skills such as time management and leadership as having a positive effect on construction project delivery. Chan et al. (2004) argue that a project leader's commitment to time affects the delivery of a construction project. A work schedule is a tool that is used to monitor the progress of work. In order to avoid delays in project delivery, the performance of the project should be evaluated regularly on this through work schedule. This helps in identifying areas of poor performance.

2.2.6 Seek people's opinion and concern

Management of an organisation should not only be concerned about work performance, but also about staff welfare. Management should not turn a blind eye to staff challenges. There should be a means for the personal challenges of workers to be made known to management. The labourers and skilled labour are those who perform construction activities with guidance from management staff, therefore their health is crucial to the speedy completion of a project. These are all factors that create job satisfaction and boost productivity.

2.3 Quality of management during construction

The study by Ponpeng and Liston (2003) of contractor ability criteria determined, inter alia, a contractor's quality management system is an important factor affecting a contractor's delivery of a project within schedule. Below are discussed the factors relative to quality of management during construction.

2.3.1 Forecasted planning date such as activity duration, resource quantities required

Planning tool is an aid for an effective, smooth flow and control of works during the construction phase. Arditi and Mohammadi (2002) conclude that timeliness, which is completion of the contract on the scheduled date, and accuracy, which is the ability to provide the right service performance may be uncovered and solutions found.

2.3.2 Analysis of construction methods

An analysis of construction methods is the consideration of the various techniques to carry out work against the volume and complexity of work, which will result in timeliness, cost effectiveness, quality product, and safety. Failure to do this might result in mistakes and rework. Proverb and Holt (2000) declare that construction methods adopted in the procurement of a project significantly relate to construction time performance. Belout and Gauvreau (2003) declare that trouble-shooting was identified as the second highest factor that explains project success in the execution stage in their study.

2.3.3 Resource movement to, on and from site

Koushki and Kartam (2004) declare that late delivery and damaged materials to site cause project delays, for instance, if there is not a particular material on site such as cement. The process it will take for replacement / purchase might lead to delays. Pertula et al. (2003) report that a total of 2 945 disability days were experienced on a project over a period of eighteen months due to accidents resulting from materials handling on site. This has a negative impact on the delivery of the project on time, with respect to machine requirements. A schedule of movement of heavy machines should be made in order to maximise the cost of hiring and movement to and from the site. Prior to a machine arriving on site the specific quantity of work to be done must have been identified. This will eliminate the situation of having the machine standing idle while work is not completed. Koushki and Kartam (2004) declare that poor planning, equipment breakdown and improper equipment lead to delays in the project.

2.3.4 Work sequencing to achieve and maintain work flow

According to Fox et al. (2003), to realise building designs, practitioners with expert knowledge should be employed in assessing the capability of construction processes. This will aid the comparison of construction methods of contractors against its adequacy regarding the project technology demand. On awarding the contract, the architect or the project manager requests the contractor to provide a work schedule and construction method statement. These explain the activities of work from site clearance to handing over of the site to the client. In other words, specific duration of activities fixed thereon and construction methods are identified. There are several planning tools employed in doing this. Among these are bar charts, the CPM, the S-curves as well as others, but the most commonly used planning tools are the bar chart and the CPM. These tools are used in achieving and maintaining workflow.

2.3.5 Monitoring and updating of plans to appropriately reflect work status

Lee et al. (2004) cite lantelme and Formoso (2000) who conclude that measurement-managed companies have shown better performance compared to their non-measurement counterparts. In order to measure the performance of a project, tools such as the CPM and bar chart are developed to monitor work status. In situations where the project is not performing as planned,

areas of weakness are identified and improved on for the achievement of overall goals. Pongpeng and Liston (2002) identify project monitoring as one of the five most important criteria for contractors' ability to perform.

2.3.6 Responding to, and recovering from problems or taking advantage of opportunities present

If a project has to repeat one of its activities, it will take longer (Hardie, 2001). There may be a multiple effect of this problem on activities, which may later lead to stagnation of works on site. These problems are identified by the daily progress record maintained on site. Where there is a lag, problems leading to it are identified. This is responding to a problem. When problems are identified, they are addressed. This implies remedying the situation and sorting out the problems. Once these are solved, the project is restored into full operation. This method employed in solving a problem could be applied to similar problems and where the project is performing well the method adopted in achieving such success should be documented and used repeatedly. Dainty et al. (2004) state that for a project to succeed, there are some qualities the project manager must possess. Among these are analytical thinking power, information seeking and initiative. These will enhance problem-solving on site. Scott-Young & Samson (2007) conclude that there is a direct and positive relationship between effective team problem-solving and project outcomes.

2.3.7 Effective coordination of resources

Tam et al. (2002) declare that site layout planning assists in minimising the travelling time and movement costs of plant, labour and materials, activity interference during construction work and site accidents. Chan et al. (2004) state that the coordinating skills of the project team leader affects the construction of a project. Kazaz and Ulubeyli (2003) are of the view that assignment decisions of resources such as labour, equipment and materials control the overall duration and cost of a project. Additionally, a good inventory system must be put in place for recording materials on site for each section, for example, concreting, carpentry, reinforcement works and mechanical and electrical work. The materials movement schedule should be developed alongside the work schedule sheet. This will afford effective coordination of resources with respect to materials in stock, materials needed and ordering dates. Together these will ensure a smooth flow of activity and timely delivery of the project. Jha and Iyer (2005) maintain that coordination among project participants and resources positively influence the delivery of projects.

2.3.8 Development of an appropriate organisation structure to maintain workflow

Bassioni et al. (2005) say that the involvement of leaders in ensuring that management systems are developed for operations is an important performance factor for success. For an organisation to function effectively there should be an organogram showing the hierarchy of authorities and the various departments in the organisation. Duties and responsibilities are spelt out to each department which assist with accountability.

3 Research Methodology

A study titled influence of management style and quality of management during construction was undertaken to identify and assess factors influencing the delivery of project relative to schedule. The study was conducted in Port Elizabeth in South Africa. The sampling frame consist architects 1149 (SAIA); master builders 320 (MBA); clients 161 SAPOA); structural engineers 43 (CESA - East Cape), and *quantity surveyors 473 (ASAQS)*. *From these the calculation of the sample size were made questionnaire response rate according to*

professional is given as: architects (9), master builders (18), quantity surveyors (23), and structural engineers (23), clients (12) and others (3).

Probability sampling technique was employed for sample selection. For the Architects, Master Builders, and the Clients random sampling was used. Systematic sampling techniques was used for the quantity surveyors, and for the structural engineers and other the entire sample were surveyed based on the recommendation of Leedy and Omrod (2005). The research instrument for this study was a questionnaire survey, which was administered to respondents through post (Architects, MB, Structural engineers, and others) and e-mail (Quantity Surveyors). These were received through the same means. Cronbach's coefficient test and validity test were performed and were found satisfactory. Cronbach's alpha of $\geq .97$ and factor loading of $>.60$ for samples sizes 85-89 were obtained.

A total of eighty-eight (88) questionnaires representing 6.1% response rate achievement recorded on questionnaire administration. Inferential analysis was used to statistics statistical tool was used for data analysis.

A five-point Likert scale adjoined with 'Unsure' and 'Does not' options was employed to analysis summated scores of the respondent's responses. Given that there are five points on the scale, and that $5 - 1 = 4$, the ranges were determined by dividing 4 by 5 which equates to 0.8. Consequently the ranges and their definitions are as follows:

- $> 4.20 \leq 5.00$ between a near major to major / major influence;
- $> 3.40 \leq 4.20$ between moderate influence to a near major / near major influence;
- $> 2.60 \leq 3.40$ between a near minor to moderate influence / moderate influence;
- $> 1.80 \leq 2.60$ between a minor to near minor influence / near minor influence, and
- $> 1.00 \leq 1.08$ between a minor to near minor influence.

Majority of the respondents belong to the private sector (74%), their average working years is 17, and over the age of thirty (30). Respondents with Bachelor's degree 25% predominate, and respondents have handled not less than six (6) types of projects. Based on these data obtained can be deemed reliable.

4 Findings and Discussion

4.1 Management style adopted

Table 1. The influence of management style factors on project delivery time

Factor	Response (%)							Mean score	Rank
	Unsure	DN	Minor.....Major						
			1	2	3	4	5		
Set time lines	2.3	0.0	3.5	0.0	14.9	37.9	41.4	4.13	1
Specify goals people are to accomplish	4.6	0.0	1.1	5.7	10.2	40.9	37.5	4.06	2
Require regular reporting on progress	2.3	1.2	2.3	3.5	17.4	37.2	36.1	3.97	3
Provide specific direction	3.5	0.0	2.3	4.6	17.2	37.9	34.5	3.96	4
Organise the work situation for people	4.6	1.2	2.3	9.2	12.6	41.4	28.7	3.79	7
Involve team members through discussion of work	2.3	1.2	1.2	4.8	20.2	35.	34.5	3.93	5
Provide support and encouragement	3.5	1.2	1.2	4.7	23.5	34.1	31.8	3.85	6
Organise the work situation for people	4.6	1.2	2.3	9.2	12.6	41.4	28.7	3.79	7
Seek people's opinion and concerns	5.0	1.3	2.5	12.5	27.5	25.0	26.3	3.54	8

Table 1 presents the respondents' rating of the influence of management style factors on project delivery time in South Africa. It is notable that all factors in this category have MSs $> 3.40 \leq 4.20$, which indicates that these factors have between a moderate to near major / near major influence on project delivery time.

The factor that has the most influence on project delivery time in this category is setting time lines. This is close in agreement with the view of Rojas and Aramvareel (2003) that out-of-sequence scheduling of work may result in a loss of momentum (rhythm), per time and subsequently lost in production. In order to achieve meaningful progress, managers need to define the number of tasks to be performed within a specified time. The lack of specification of time lines for the performance of activities may have an adverse effect on the delivery of projects. Construction activities have been described as difficult and masculine in nature. There are measures such as setting time lines which need to be applied for meaningful productivity to be achieved.

The next significant factor is specifying the goals that people are to accomplish. Construction projects consist of activities and these activities need to be specified to workers and supervisors through information given by management for monthly, weekly or daily task executions until project completion. This is partly the reason for the need to provide a work schedule. When these details are not adhered to, it may have an adverse effect on the delivery time of projects. This agrees with the declaration of Pheng and Chuan (2005) that the defining of goals affects project performance positively.

The least significant factor in this category, is sorting peoples' opinions and concerns. It is a managerial tool used for higher productivity, which is often not utilised. Workers are not very skilful in contributing ideas to improve work execution. Most of the workers are afraid to speak to their supervisors. These are the most likely reasons for this factor having the lowest impact on project delivery time.

4.2 *Quality of management during construction*

Table 2. The contribution of quality of management during construction factors on project delivery time

Factor	Response (%)							Mean score	Rank
	Unsure	DN	Minor.....Major						
			1	2	3	4	5		
Effectively coordinating resources	3.5	0.0	2.3	4.7	19.8	36.1	33.7	3.92	1
Developing an appropriate organisational structure to maintain workflow	3.5	1.2	1.2	5.8	19.8	36.1	32.6	3.88	2
Forecasted planning date, e.g. activity duration, resource quantities required, etc.	4.7	1.2	4.7	4.7	16.3	37.2	31.4	3.80	3
Responding to recover from problems or taking advantage of opportunities presented	6.9	0.0	2.3	6.9	21.8	32.2	29.9	3.77	4
Monitoring and updating plans to appropriately reflect work status	2.4	0.0	3.5	10.6	29.4	23.5	30.6	3.66	5
Analysing of work sequencing to achieve and maintain workflow	2.4	0.0	3.5	10.6	29.4	23.5	30.6	3.66	6
Analysing resource movement to and on site	3.6	1.2	1.2	13.1	29.8	32.1	19.2	3.50	7
Analysing construction methods	2.4	3.5	4.7	7.1	35.3	28.2	18	3.38	8

Respondents were required to rate the influence of quality of management during construction factors on project delivery (Table 2). Seven out of eight factors have MSs $> 3.40 \leq 4.20$, which indicates that factors have between a moderate to a near major / near major influence on project delivery time.

The most influential factor in this range is effectively coordinating resources. The lack of effective control of resources, namely machines, materials and human resources may lead to disorder on construction sites. A clash of activities, which may in turn lead to a lack of materials on site and a shortage of labour on site, may in turn result in low productivity. These all have an adverse cumulative effect on delivery time of project. This factor concurs with the findings of Chan et al. (2004) that the coordinating skills of the project team leader affects the construction of a project and Kazaz and Ulubeyli (2003) who are of the view that assignment decisions of resources such as labour, equipment and materials control the overall duration and cost of a project.

The next significant factor is developing an appropriate organisational structure to maintain workflow. Construction activities are carried out by issuing instructions, and providing guidance and support. Instructions are given by superiors to subordinates. The labourers and supervisors must be aware of whom they must take instructions from and to whom to report to. A situation where these are not well defined may lead to poor performance on the project. A well-defined organisational structure will assist in the maintenance of steady workflow. This finding is in line with the finding of Bassioni et al. (2005) declaring that the involvement of leaders in ensuring that management systems are developed for operations is an important performance factor for success

The factor with the lowest MS in this range is analysing movement of resources to and from the site. The various times resources are required on site should be estimated in order to avoid idleness which engenders waste. These could be in the form of time losses, which is indirectly wasting money, and may lead to bankruptcy and abandonment of the project. Koushki and Kartam (2004) declare that late delivery and damaged materials to site cause project delays.

The findings of this study agrees with most findings of studies that have been conducted in different countries in the world. With respect to management style adopted on workers specification of goals workers are to achieve was declared by Pheng and Chuan (2005) as adversely affect workers productivity when they are not set. Relative to quality of management during construction these were found: effectively coordinate resources (Tam et al., 2002); develop appropriate organization structure (Bassiani et al., 2003), and forecasted planning date (Arditi and Mohammed, 2002) as having adverse effect on project delivery time, when adequate measures are not in place to mitigate their effect on project delivery time.

5 Conclusion and Further Research

5.1 Conclusions

The study reached these conclusions, that the following adversely affects project delivery time when attention are not given to them: set time lines, specify goals people are to accomplish, require regular reporting on progress, effectively coordinating resources, developing an appropriate organisational structure to maintain workflow, and forecasted planning date, e.g. activity duration, resource quantities required, etc. In order to mitigate the effect of the findings, it is recommended that weekly planning of resources and gang size should be developed. This is relative to mitigating materials shortages and achievement of target output of production, and ensuring correct activity sequencing. In addition, selecting adequate gang sizes to task.

Identification of key performance factors such as physical and socio-cultural factors that could impede on construction speed are recommended for further research.

6 Acknowledgement

The authors appreciate the financial support received from the Research Unit of the Durban University of technology, for making this study publishable. We are indeed grateful.

7 References

- Andawei, M. M. (2003) Critical Path Method: A tool for project Delay Control. *The Quantity Surveyor*, 44 (3), 2-5.
- Bassioni, H. A., Price, A. D. F. and Hassan, T. M. (2005) Building a Conceptual Framework for Measuring Business Performance in Construction: An Empirical Evaluation. *Construction Management and Economics*, (23), 495-507.
- Belout, A. and Gauvreau, C. (2004) Factors influencing project success: The Impact of Human Resource Management. *International Journal of Project Management*, 22 (1), 1-11.
- Chan, A. P. C., Scott, D. and Chan, A.P.L. (2004) Factors Affecting The Success of a Construction Project. *Journal of Construction Engineering and Management*, ASCE 130 (1), 153-155.
- Dai, J., Goodrum, P. M. and Maloney, W. (2007) Analysis of Craft Workers' and Foremen's perceptions of the Factors Affecting Construction Labour Productivity. *Construction Management and Economics*, (25), 1139-1152.
- Dainty, A.R.J., Cheng, M. and Moore, D.R. (2003) Redefining Performance Measures for Construction Project Managers: An Empirical Evaluation. *Journal of Construction Management and Economics*, (21), 209-218
- Edum – Fotwe, F.T. and McCaffer, R. (2000) Developing Project Management Competency: Perspective from the Construction Industry. *International Journal of Project Management*, 18 (2), 111-124
- Fox, S., Marsh, L. and Cockerham, G. (2003) Assessing the Capability of Construction Processes to Realize Building Designs. *Construction Management and Economics*, (21), 7-10.
- Fryer, B. (2004) *The Practice of Construction Management. 4th Ed*, Oxford: Blackwell Publishing.
- Griffith, A. and Watson, P. (2004) *Construction Management Principles and Practice. 1st Ed*, New York: Palgrave Macmillan.
- Hardie, N. (2001) The Prediction and Control of Project Duration: A Recursive Model. *International Journal of Project Management*, 1, pp. 401-409.
- Jha, K.N. and Iyer, K.C. (2006) Critical Determinants of Project Coordination. *International Journal of Project Management*, 124 (4), 314-322
- Koushki, P. A. and Kartam, N. (2004) Impact of Construction Materials on Project Time and Cost in Kuwait. *Engineering, Construction and Architectural Management*, 11 (2), 126-132.
- Lantelme, E. And Formoso, C. T (2000) Improving Performance Through Measurement: The Application of Lean Production and Organisational Learning Principles. *Proc. IGLC – 8. International Group for Lean Construction*, Brington.
- Lee, H., Yu, J. and Kim, S. (2004) Impact of Labour factors on Workflow. *Journal of Construction Engineering and Management*, 130 (6), 918-923.
- Leedy, P. D. And Ormrod, J. E. (2005) *Practical Research: planning and design. 8th Ed*. New Jersey: Pearson Prentice Hall.
- Ogunsemi, D. R. and Jagboro, G. O. (2006) Time - Cost Model for Building Projects in Nigeria. *Construction Management and Economics*, (24), 253 – 258.

- Perttula, P., Merjuma, J., Kiurula, M. and Laitinen, H. (2003) Accidents in Materials Handling at Construction Sites. *Construction Management and Economics*, (21), 729-736.
- Pheng, L. S. and Chuan, Q. T. (2006) Environmental Factors and Work Performance of Project Managers in The Construction Industry. *International Journal of Project Management*, 24 (1), 24-37.
- Pongeng, J. and Liston, J. (2003) Contractor Ability Criteria: A Review from the Thai Construction Industry. *Journal of Construction Management and Economics*, (21), 267-282
- Proverbs, D.C. and Holt, G.D. (2000) A Theoretical Model for Optimum Project (Time) Performance Based on European Best Practice. *Construction Management and Economics*, (17), 652-665.
- Rees, W. D. and Porter, C. (2001) *The Skill of Management*. 5th Ed. Publishers: Thomas learning, London.
- Scott-Young, C and Samson, D. (2009) Team Management for Fast Projects: An Empirical Study of Process Industries. *International Journal of Operations and Production Management*. 29 (6), 612-635.
- Sing, T. F. (2002) Time to Build Options in Construction Processes. *Construction Management and Economics*, (20), 119-130.
- Smallwood, J.J. (2006) The Practice of Construction Management. *Acta Structilia*, 13 (2), 25-42.
- Walker, D. H. T. and Shen, Y. J. (2002) Project Understanding, Planning, Flexibility of Management Action and Construction Time Performance: Two Australian Cases Studies. *Construction Management and Economics*, (20), 31-44.

IDENTIFYING HAZARDS FACING WORKERS IN CEMENT FACTORY IN PRETORIA

Samuel, Segun Victor; Talukhaba, Alfred Atsango; Opaleye, Oladele Solomon
Department of Building sciences, Faculty of Engineering and the Built Environment, Tshwane University of Technology, Pretoria, Gauteng, South Africa

Abstract

The purpose of this study is to minimize the major hazards encountered by the cement factory workers. Cement workers are prone to hazards and these has potential cause to injury or illness which is the basic motive for this study. Hazards was identified and assessed, qualitative and quantitative methods are used in collecting data in this study. Data collection method are based on individual interview with the management, workers and the labour contractors in the factory. The researcher was able to get good response from the workers by assuring them that the information obtained from them would only be used for the study and that their employer will not have access to it. Some events photographs was taken as it buttress the authenticity of the study findings. The findings shows that workers encounter risks of throat cancer, reddish eyes skin problems and breath problem which was attributed to inadequate provision of PPE by the management and the contractors that directly employed these workers. The study recommended that safety performance should be improved by the stakeholders in the cement industry through effective monitoring visit by the department labour to cement factory, provision of PPE by the management, safety training programmes for workers, employment of competent safety personnel will enforcement safety compliance in the factory.

Keywords: Cement, Factory, Hazards, PPE, Safety

1 Introduction

Cement factories represent one of the most important strategic basic elements in the economic development of any country. Workers in this sector constitute an important productive aggregate in the community (David and Hamdy, 2005; and Baskett, 2007:7). Furthermore for period of time the national development was measured by production and consumption size of the cement (Pipilikaki, 2009). The cement industry operates in virtually all countries around the world; however more than 70 percentages of the global cement are produced and consumed in the developing countries where the cement development is much higher pace (John, 2003). This industry has all the features to be a successful sector especially in some developing countries, like South Africa.

Portland cement is the most commonly used today and is successor to hydraulic lime. The invention of Portland cement is usually attributed to Joseph Aspdin, who took out a patent in 1824 for a material that was produced from a mixture of limestone and clay. It is called “Portland” because the concrete made from it looks like natural stone from the Isle of Portland. Since Roman times, cement has been one of the synthetic materials with the largest production and widest usage by mankind. Its properties have allowed fascinating works till date. In the cement factory sector, workers exposed themselves to many occupational hazards that might

contribute to diseases and injuries at the cement factory but a considerable interactive effort with exchange of ideas in many organisations within and outside the cement industry have been trying the need of stressing on how to improve occupational health and safety performance for workers. Furthermore a periodic check-ups and early detection of hazards to monitor the health status of every cement factory work-related accidents and diseases continue to be a major problem in the world today, because the human and economic costs of occupational accidents and diseases remain high major tieback for cement factory (Abongomera, 2008:46). Working is viewed as important part of one's life experience of all adults, as most people spend about one third of their lives at work. About 45% of the world's population and 58% of the population over ten years of age constitute the global workforce Rogers (2005) and Gupta *et al.* (2007).

El - Sobky (2008), indicates that workers are exposed to many health hazards which are tremendously harmful on their health, these hazards may result from physical, chemical and mechanical agents, which could have a detrimental influence on their health. Cement can cause ill health in workers through skin and eye contact or inhalation. The risk injury attached to the cement factory workers depends on the duration and level of exposure and individual sensitivity. (Saucier and Jane, 2004:45). The term "cement" was derived from the Latin word *cementum*, which means stone chippings that were used in Roman mortar. This hydraulic cement was discovered during ancient Greece and Rome where it was made from volcanic ash mixed with slaked limes, and the Roman engineer Vitruvius describes the surprising properties of this mixture differed completely from all other materials and was even able to set under water by Smeaton, 1758. There are difficulties to determine the extent of work-related illnesses and diseases because of the delayed period of most occupational diseases on workers in the cement factory. Environmental Health and Safety Management (2009) explains that some of the diseases do not emanate on the workers' health quickly as expected. When the diseases finally manifest it is often difficult to trace the root causes to the workers' past exposure (El-Sobky, 2008:46). The International Labour Organisation (ILO) observed in 2008 that more than two million workers die each year from work-related accidents and diseases, and added that this is probably an underestimation. The ILO estimates that workers suffer 270 million accidents and at least 335 000 fatal injuries annually, while avoidable occupational diseases affect 160 million people every year. The results of a study by (McCann and Babin 2007:10) show a need for good dilution ventilation and additional protective gear such as goggles and NIOSH-approved toxic dust masks for workers in the chemical industry. This is very important for the cement chemical section; as such masks will protect the workers from hazardous toxic materials. Many cement factories around the globe are re-examining their factory operations in a fundamental way.

Many health and safety legislative and regulatory frameworks specify, in clear terms, how the employer must address any given condition. Taylor (2003:12) explained that the standards and regulations tend to support the traditional command-and-control, deemed to comply or prescriptive approach of addressing unsafe situations as well as existing and potential hazards, while ignoring the responsibility of the employer in addressing unsafe worker behaviour, cement Factory have started making significant changes to their policies and commitments to health and safety strategies to improve the sustainability of cement production, providing and enforcing prescriptive rules and procedures that promote the safe behaviour of workers (Haupt, et al, 2001:3).

1.1 Research Problem Statements

The cement is mostly found everywhere in everyday life and it is hard to imagine a modern society without it. But workers in these cement factory are exposed to many occupational hazards which contribute to work injuries, while some workers become allergic to chromium content in cement component. A significant percentage of all workers in cement factory are

allergic to chromium dust particles in cement, these cement dust particles symptoms ranging from a mild rash to severe skin ulcers. (Zuskin, et al., 2007), reported that cement, had a significantly higher prevalence of chronic cough, chronic bronchitis, hearing disorders and chronic sinusitis attacking workers health in workplace.

In order to achieve comprehensible understanding of the cement industry features, and all effective factors during the production process; this attempts give a clear picture of the cement production problems occurrence. Furthermore it shows that both workers and people living in the vicinity of cement factories are at risk, as it has been suggested that the components of cement dust can be airborne and inhaled. When the cement dust enters the bloodstream it is transported to the different tissues of the body, including the liver, spleen, heart, bone, and muscles. This could affect the physiological micro-structure and performance, and if an irritation of the eyes is not treated immediately, chemical burns leading to blindness can be caused (Saucier and Janes, 2004). According to Baletic, et al., (2005), indicated in their study that most of the avoidable hazards were caused by level of workers education that made most of them not understanding the safety rules in the safety hand book given to them at the commencement of their duty at the cement factory, 86% of workers had primary education, while 1% is semi-qualified and 13% are qualified workers in cement factory. As such the study shows workers' exposure to various occupational health hazards that causes various kind of illness in the cement factory workers' health, these are physical, chemical or accidental due to mechanical hazards and other health problems. The physical hazards show that ear problems are the most common physical hazards observed in the cement factory, this was followed by high blood pressure of the workers. Slightly less than one quarter of the studied sample were exposed to fractures because of accidents, followed by falling object. Also, slightly less than one fifth of the studied samples were exposed to eye problems, followed by haematological disorders. However, it is very difficult to convince employee, management and sub-contractors that the improvement of working conditions could be profitable and that the improvement of health and safety at work could generate enormous economic benefits; not only for the factories, but also for society as a whole (Mansour, 2008:9).

The primary objective of the study is to improve management awareness of workers' health and safety in the cement factory.

The secondary objectives of the study are as follows:

- To investigate how management can improve workers' health and safety.
- To identify the hazards that workers are exposed to at work.
- To evaluate the magnitude of the hazards that workers are exposed to.

To improve management's accountability for supervision health and safety issues among workers, and management improvement on the health and safety issues in the cement factory. Major Key of the study is the health hazard to which workers are exposed to and how cement factory management deals with this issue, is a challenge. The implementation of health and safety policies, as well as the accountability of management toward the health of workers that relate to cement factory, this hazard requires study.

2 Literature Review

Cement can be defined as the critical ingredient in concrete, locking together the sand and gravel constituents in an inert matrix; it can be referring to as 'glue' which holds together modern society infrastructure. The cement industry is one of the oldest industries in the world. The demand for the cement has risen rapidly over the last decades to become the second substance after water (Hsiao & Armstrong, 2012: 28). The industry is high intensively of raw materials and energy with fuel accounting for 30-40% of the production costs. Cement has been

made since Roman days, but over time the recipes used to produce cement have been refined and earliest cements were produced from lime and pozzolana called volcanic ash, containing significant quantities chemical mixture with ground brick and water. Moreover this cement was not improved until 1758, when Smeaton" noticed that using a limestone that was 20 - 25 % clay and heating the mixture resulted in cement could harden under water. He called this new cement 'hydraulic lime. Furthermore when the mixture was heated, a small quantity of it was sintered. Normally this was discarded as waste, but in the 1800s Aspdin and Johnson, discovered that when the entire batch was sintered and then ground superior cement was formed and produced. This further research substance became designated as Portland cement after the region in which they were working; today this is the most common cement in use.

Production of cement deals with raw materials and the main raw materials used in the cement manufacturing process are, limestone, sand, shale, clay, and iron ore. Another source of raw materials is industrial by-products to replace natural raw materials this is key element in achieving sustainable development of cement production. Cement is produced through a series of processes including quarrying, crushing, milling, blending and kiln burning, to form clinker cement. During all these processes accidents cannot be avoided, due to the ever-increasing pace of production activities. There are two main types of cement, natural and artificial. The natural cement is obtained from natural material having a cement-like structure and requires only calcining and grinding to yield cement powder, while artificial cement is also called Portland cement, there are different types of Portland cement such as Ordinary or Rapid hardening, Sulphur resisting, White coloured, Low heat, Masonry, Hydrophobic, Water replant, Expanding and non-Shrinking, High aluminium, Blast furnace and Oil well. All these are produced under consideration of different substances especially the limestone and clay, which are heated into a chemical reactions which take place, during heating process this produces four major phases which are known as Tri-calcium silicate, Di-calcium silicate, Ferrite phase and Tri- calcium aluminates phase (Hsiao and Armstrong, 2012:7).

Hamdy (2007) in his own research revealed that Cement mill workers are exposed to dust at various manufacturing and production processes, such as quarrying, handling of raw material, grinding clinker, blending, packing and shipping of the finished product, he also submitted that those workers who are exposed to such hazards in their workplace are more exposed to health hazards. In recent times the disastrous accidents in Bhopal (India) and Chernobyl (Ukraine) had a death toll of an estimated 4 000 and 10 000 persons respectively in 2000. In addition, there were around 5 200 workplace fatalities and 3.9 million workers suffered disabling injuries in the United States. This clearly demonstrates that the problem of workplace accidents and safety is a pressing issue. Noise is also major hazard encounter during the production of cement; milling plants used in grind the cement product causes high tension of noise this can simply damage someone hearing Levels, maintenance and cleaning personnel worker are mostly at risk. Improved noise personal protective equipment is also helping reduce the effects of exposure, and a whole body vibration is another issue in cement factories. (Beach, 2009), explains that age actually had stronger effect upon accident rate in the workplace. The United States Department of Health and Human Services (USDHHS, 2000), reported that workers having years of experience more than 10 years were more exposed to hearing serious effects. Though work-related diseases are amenable to prevention through recognition, evaluation and control of the hazards in an ideal world and effective practice of occupational health and safety has yet to be fully adopted in these developing countries. Baloyi (1991) identified the following as some of the main reasons for not implementing the safety policy by most developing countries: lack of effective enforcement system, lack of information and accurate records of occupational diseases and accidents with lack of basic professional training lack of risk management, risk engineering, risk control in occupational health and safety of cement factory.

Evelyn, Florence and Adrian (2005), presented the results of a postal survey of contractors in Singapore, where the findings revealed that factory accidents are more likely to happen when there are inadequate factory policies. Moreover, the health and safety policy statement should contain the aims which are not measurable and objectives which are measurable of the organisation or factory. The aims will probably remain unchanged during policy revisions, whereas objectives will be reviewed and modified or changed each year. These statements should be written in clear and simple language so that it is easily understandable (Phi Hughes *et al.*, 2001). These following points should be considered when a health and safety policy statement is drafted:

- The aims should cover health and safety welfare and relevant environmental issues.
- The position of the senior person in the organisation or company who is responsible for health and safety (normally the chief executive).
- The names of the health and safety adviser and any safety representatives.
- A commitment to the basic requirements of the Health and Safety at Work Act, for example, risk assessments, safe plant and systems of work, transport and handling of articles and substances, information, training and supervision.
- Using a safety committee or plant council.
- Specific policies of the organisation.

Risk engineering is one of the department found in the cement factory, generally it involves the use of engineering measures to reduce or eliminate risk in any factory sector. The control measures used by management as a link between risk control and risk engineering take into account that if hazards are controlled then the associated risks will be minimised. A range of counter measures is available to lower workers' risks. They involve reviewing the tasks, engineering, guarding, methods, training, Personal Protective Equipment policy, substitution, shielding, practices, information, and worker behaviour (Flanagan, as cited by Radevsky, 2011:3). Risk engineering is also a process in which a risk engineer undertakes surveys at regular intervals during the project life cycle. The main purpose of the process is the prevention of losses by examining the performance and progress of the works, identifying key areas of risk, providing recommendations, analysing losses and sharing lessons learned with the operational teams. This is achieved through regular visits to the site and a discussion of the recommendations with the workers (Radevsky, 2011:4). Another purpose of risk engineering is that of reporting the progress to the management, including recent or imminent changes and highlighting problems that have been encountered, discussing delays that have been faced and how the workers responded to them; and noting the responses to any recommendations made during previous surveys. To accomplish this, information is gathered before, during and after cement factory visits. Subsequently, a report is produced which is sent to the workers and the management (Radevsky, 2011:5).

It is important to imbibe risk control by eliminating or reducing the risk of a person being injured or harmed. The order in which controls should be considered is elimination, substitution, isolation, engineering control, administration control, and personal protective equipment. It should be noted that more than one control can be used at any given time to reduce the exposure to a hazard resulting from manual handling (DoL, 2011:8). The management of Health and Safety at Work Regulations 1999 of the UK states that risk assessment should include, firstly, a record of the preventative and protective measures that are in place to control the risks, and, secondly, what further actions, if any, are to be taken to reduce risk sufficiently (Cooke and Williams, 2009: 247).

Preventative and protective measures are often referred to as control measures; the purpose of this is to reduce worker risk. This is not always achievable; therefore, further measures may

need to be implemented to control any residual risks (Chihuri and Pretorius, 2010: 57). For example, a measure might be to provide workers that work at heights with safety harness for a particular work. However, there is still the risk that the workers will not use the tool correctly. The residual could be minimised to an acceptable level by employing a foreman to supervise the task of ensuring that the worker safety regulations are adhered to (Cooke and William, 2009: 248). Risk cannot be eradicated, but it can be managed (Chihuri and Pretorius 2010: 69). Furthermore, it is better to be proactive than reactive. Risks have to be identified, quantified and understood for them to be effectively managed (CIDB, 2004:1). Risk management now serves as an iterative process consisting of distinctive steps which, taken in sequence, support better decision-making by contributing a greater insight into risks and their impacts. The risk management process can be adopted in any situation where an undesired or unexpected outcome could be important or where opportunities are identified (Dey, 2010:69). These address the importance of risk identification and risk analysis in the cement factory. The cement factory is ideal example of the continuous industry sector and it will be used to demonstrate that the lean philosophy is applicable to all deferent organisation types. There are numerous challenges facing the cement factory in today's competitive environments; one of the major challenges is the capability of the cement factory to adopt safety enforcement to sub-contractors and introduce the improvement approaches and techniques by which the overall enhancement can be achieved.

3 Research Methodology

To achieve the objective of this research qualitative and quantitative method was used, 48 workers, 10 contractor and 15 management staff were interviewed. This method offers sufficient flexible results for all the research questions and objectives of the study were addressed, the relevant areas of data collection, the interviews were tape-recorded to secure an accurate account of the conversations and avoid losing data since the entire conversation cannot be captured during an interview by other means. Observations was also made by the researcher so as to obtain useful information that will proffer result that can address the problem identified in the study. The researcher observed both physical setting and environment within which the cement factory workers activities took place.

4 Data Collection

Data was collected through interview and observation from the cement factory, workers, contractors and management were randomly interviewed on different days based on the activities of each worker on their workplace, the qualitative method was used in collecting information from the targeted group; observations are also importantly made on the attitude of workers and their employers concerning the safety of the workers on the cement factory used in this study. Interviews and observations are popular means of obtaining information from people (Noor, 2008: 1603). The interviews was tape-recorded to secure an accurate account of the conversations and avoid losing data as stated above since the entire conversation cannot be captured during an interview by other means, journal and textbook to find answer to the objective of the study and explain improvement to workers about health and safety. The approach used in this study was qualitative in nature. The researcher made use of the simple random sampling within the category of the probability sampling methods. According to Ogbeide (1997), the justification for this kind of technique allows every subject in the sampling frame an equal opportunity to be selected without bias in an organized manner.

5 Findings and Discussion

It was observed that the management provided PPE to the permanent workers but left out other subcontractors` workers believing that their employer will provide them with PPE, the

management provided: Nose guard, Hand glove, Safety Hat, Safety Boot, Safety Gurgle and Ear noise guard. The researcher also noticed that some of the PPE given to the workers employed by the management are not properly used by their worker. Contractors hardly provide proper PPE stated above to their workers especially those workers at the production floor where there are inhaling of dust that affect workers' health. Out of the 48 workers interviewed 17 of them agreed that the management provided proper and adequate PPE while 10 workers neutrally agreed that management provided PPE but was not adequate and the remaining 21 workers believed that management did nothing in respect of the workers protection against hazards. The research sampling shows that workers that agreed to management provision of PPE but not enough are those contractors' workers that were opportune to get some of the PPE provided by the management and those workers that disagree are the workers that hardly get some of these PPE. In conclusion the following finding were made:

- Poor supervision of the workers at workplace;
- Risky behaviour of workers at the factory;
- Inadequate safety education, illustration and proper use of safety harnesses;
- Inadequate provision of safety harnesses;
- Employment of incompetent safety officers by the sub-contractors;
- The attitude of the management towards workers employed by subcontractors in respect of their H&S at the factory premises;
- Improper use of PPE by the workers;
- Provision of defective PPE by the sub-contractors to the workers;
- Improper use of workplace equipment (e.g., steel ladders) by the workers;

The demographic analysis below could also explain the numbers of the respondents in this study and their response to questions asked. On the side of the workers in respect of their responsibility to their health and safety protection at work, the following histogram in Figure 1 shows that large percentage of the workers did not comply with the health and safety at work.

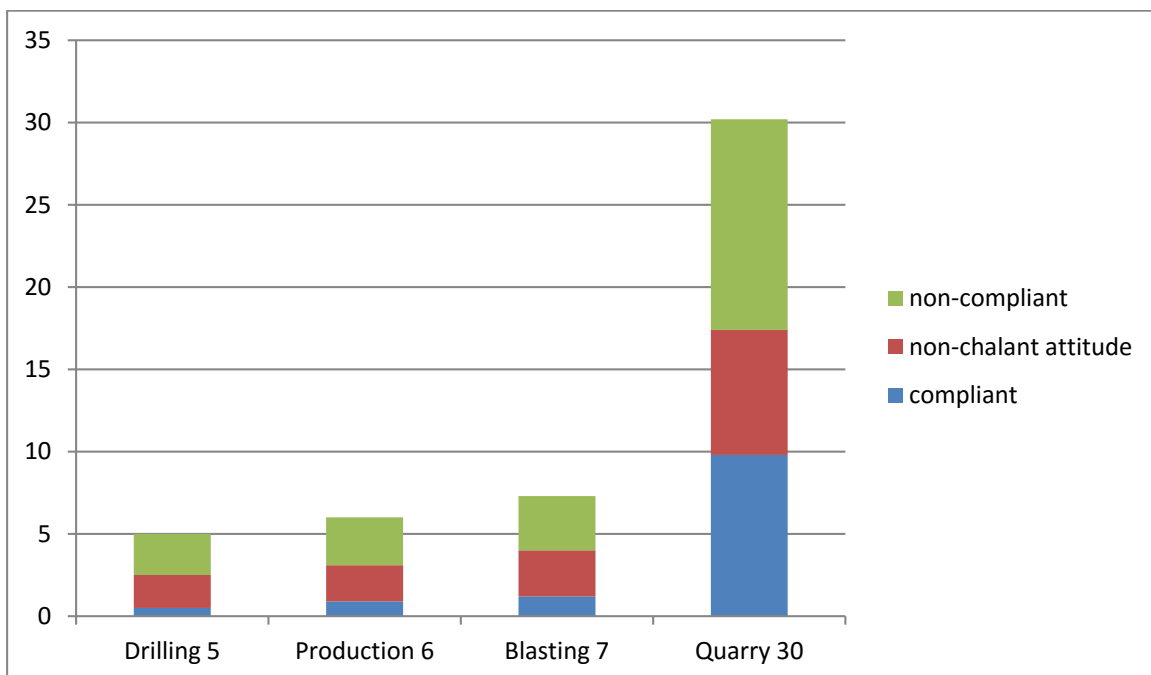


Figure 1. Workers attitude towards their personal protection

This question was asked and the sample result shows with the aid of histogram that out of the 48 workers interviewed 30 workers from the quarry as the highest percent of non-compliant in using the proper PPE while the others are in between. This shows that according to the result and observation in the factory contractors are the non-compliant figures in the issue on ground because they focus mainly on their daily target when job are being awarded to them.

6 Conclusion and Further Research

The data obtained in this research were based on the personal views of the participants, the observations of the researcher and not on any assumptions that may have been made by researchers about what the causes the workers hazards. The results indicated that serious injuries and death among the cement factory workers are caused by the findings mentioned above. Based on the above findings it appears that the major stakeholders concerned with the workers hazards at the factory workplace need serious redress, the shortcomings on workers hazardous issues at the workplace. Further research is being recommended by the researcher.

7 References

- Abdelhamid, T.S., Narang, P & Schafer, D, (2011). Quantifying Workers' Hazard Identification Using Fuzzy Signal Detection Theory: The Open Occupational Health & Safety Journal
- Abongomera, A. (2008). Identified the human and economic occupational cost accident diseases.
- Alphonse, T. (2008). Decent work and global strategy on occupational safety and health On Guard Sustainable. *Safety and Health Practice*, 15 (1): 7-13
- Akpan, E. I. (2009). Participative goal-setting: A strategic approach to achieving increased productivity in contemporary organizations. *Oxford Mosai. Journal of Business Strategy*, 1: 37-47.
- Andi (2008). *Civil Engineering Dimension*, 10(1):1-6.
- Ayodele, R. B. and Olubayo-Fatiregun, M. A. (2010). Workability of safety education and training for workers' strategy in accident induction in selected manufacturing industries in Lagos. *International Journal of Sustainable Development*, 3:8-14.
- Baby, S., N. A., Singh, P., Shrivastava, S. R., Nath, S. S., Kumar, D. S. and K. Vivek (2008). Impact of dust emission on plant vegetation vicinity of cement plant" *Environmental Engineering and Management Journal* 7(1): 31-35
- Zhi, H. (1992). Risk management for construction projects. *International Journal of Project Management*
- Baloyi, (1999). Identified some of the reason why industries are not implementing safety policy
- Besides, T and Spilka, M. (2010). Achievement in materias. *Journals of Achievements in Materials and Manufacturing Industry*, 39(1):95-102. C., M. 2008. In: Asia Construct Conference [Online]. Available from: [Accessed: 21/02/2015]
- Chao, C.J., Wang, H.M. and Cheng, F.-Y. (2008). A study for safety and health management problem of semiconductor industry in Taiwan. *Industrial Health*, 4, 575–581.
- Cooke, B. and Willimas, P. (2009). *Construction Planning, Programming and Control: Wiley-Blackwell.*
- Christian, M., Brandley, J., Wallace, J. C. and Burke, M. (2009). Workplace safety: a metaanalysis of the roles of person and situation factors. *Journal of Applied Psychology*, 94 (5), 1103–1127.
- Dey, D. (2010). Making work safer: Testing a model of social exchange and safety managemen. *Journal of Safety Research*, 41:163-171.

- Eklof, M. (2008). The impact of systematic health and safety management for occupational disorders and long-term work attendance. *Social Science and Medicine*, 67, 965-970.
- El-Sobky, M.K. (2008). Study of accidents among workers Helwan cement factories. MD Thesis, Faculty of Medicine, Cairo University Egypt.
- Flanagan, R and Norman, G. (2001). Risk Management of Construction. ASC Proceeding of the 37th Annual Conference University of Denver- Denver, Colorad.,April 4-7 2001,(95-100).
- Grant, A., Christianson, M. and Price, R. (2007). Happiness, health, or relationships Managerial practices and employee well-being tradeoffs. *Academy of Management Perspectives*, 21 (3) (51-63).

INFLUENCE OF CONSTRUCTABILITY AND QUALITY OF MANAGEMENT DURING DESIGN FACTORS ON PROJECT DELIVERY

Aiyetan, Ayodeji.Olatunji

Department of Construction Management and Quantity Surveying, Fac. of Engr., Built Env. and Sciences, Durban Univ. of Techn., Durban, KwaZulu-Natal, South Africa

Smallwood, John Julian; Shakantu, Winston

Department of Construction Management, Faculty of Engineering, the Built Environment, and IT, Nelson Mandela Metropolitan University, Port Elizabeth, Eastern Cape, South Africa

Abstract

Constructability, the integration of construction techniques at the stage in the development of designs has impact on the rate of construction. When this is absent it normally results in a negative impact. The aim of the study is to identify influencing factors of constructability and quality of management during design have on project delivery time with a view to alleviating their impact. A questionnaire survey was conducted among professionals in the Building Construction Industry to access influencing factors of constructability and quality of management during design. A total of eighty-eight questionnaires were analysed before reaching conclusion relative to the study. Inferential statistics was employed in the analysis of data. Finding relative to constructability factors include that participation in site inspection and control, knowledge of performance of materials and components, and appropriateness of working space and for quality of management during design, conflicting design information, missing information and timeliness of revised drawings are the factors that most influences project delivery time. The recognizing of influencing factors of constructability and quality of management during design, could result in according more priority to them with a view to developing measures to mitigate their effects on project delivery. Based on the finding of the study, ways to mitigate poor constructability reviews and quality of management during design were highlighted.

Keywords: Construction, Constructability, Delivery time, Design, Management quality

1 Introduction

Clients expects the briefings of their intended facility to the designer to be accurately reflected in design and so built by the constructor. Client's desire is to procure a facility that is performing optimally. Contrary to these, dissatisfaction results, which may lead to litigation, extension of time, no returns on investment as planned by the client, and so on.

The ease of construction of a design is referred to as constructability. Constructability indicates the following: corresponding dimensions of design, adequate and accurate design information, and design void of omissions, which ultimately leads to delivery of facility as schedule, facility performing optimally to the satisfaction of the client.

The contrast is the case, relative to poor design and non-constructible design necessitating late delivery of projects, with a lot of problems associated to it. This study aims to identify and

assess factors of constructability issues and quality of management during design that could adversely influence project delivery time, with a view to suggesting mitigating factors.

2 Literature review

2.1 Importance of the study

The non-delivery of a project as at when specified causes unhealthiness in a contract and may lead to abandonment, disputes and litigation, increased project duration and cost resulting from inflation, bad image of contractor, client and consultants, and so on. Delay is associated with diverse issues, which are traceable to the contribution of the client, contractor, and consultant – designer, with respect to this study (Niazai and Gidado, 2012). Contribution from the designer could relate to issues of constructability of the design and quality of management during design. Some authors have identify factors relating to design that causes project delay. They are: design complexity (Sullivan and Hans, 1986); changes in scope of work (Assaf et al., 1995); waiting for information (Chan and Kumaraswamy, 1997) and design delay (Ogunlana et al., 1996); design changes (Kaming et al., 1997); Trigunarsyah (2004) identifies four stages of constructability implementation on a project. The stages are: during conceptual planning, during design, during procurement and during the construction stage, and each having sub-factors for consideration; late preparation and approval of drawings (Faridi and El-Sayegh, 2006); design (Long et al., 2008); late approval of shop drawings (Assaf and Al-Hejji, 2008), and ambiguities, mistakes, and inconsistencies in specification and drawings (Shehu; Endut, and Akintoye (2014). Based on these gaps, this study was initiated in South Africa, in addition that building construction processes are the same worldwide, to assess the factors that most influence delivery time of project based on issues of constructability of design.

2.2 Constructability of design

Mbamali et al. (2005) define the extent to which a building design facilitates the ease of construction as buildability: a British term or constructability: an American term which is defined as the grouping of similar work components and the use of modular dimensions in design to reduce construction cost. The constructability requirement is, however, one of the major factors necessitating the integration of construction experience into building designs. Oyedele and Tham (2005) provide a list of factors that could be used to assess constructability inter alia: flexibility of design to changes; dimensional coordination of elements; knowledge of performance of materials and components; effective constructability review of design, and effective participation in site inspection and control. The following factors are employed in the assessment of design constructability: the scope of off-site fabrication; complexity of offsite fabrication components; appropriateness of design tolerances; appropriateness of working space; implication upon trade coordination; impact of materials storage and movement, and impact on smooth activity workflow and activity sequencing.

2.2.1 Extent of grouping simultaneously

The extent to which similar kinds of work can be grouped together is an indication of how fast a design can be constructed. Works such as fixing of electrical wires into pipes for switches and sockets allow projects to gain time, because the wires to many switches and socket outlets can be contained in one pipe, with minimum cost. The extent to which a design can easily be changed also reflects how easily it can be constructed. Designs that are not subject to changes could have an adverse effect when errors are committed during construction. These errors could be design or construction related errors.

2.2.2 Extent of modular dimension in design

The utilisation of modularity in design facilitates easy and fast construction. The use of standard modules promotes standard sized materials and mitigates cutting. When standard items are customised in this way, projects may be completed more speedily. Additionally, the incorporation of these standard units in design can eliminate the delays relative to cast in-situ operations.

2.2.3 Knowledge of performance of materials and components

The knowledge of performance of materials and components provides opportunities for alternatives. Trigunarsyah (2007) suggests that the concept of constructability revolves around optimising the use of construction knowledge and experience provided by knowledgeable and experienced construction personnel who are part of the project team. The project managers, engineers, architects, and contractors should be knowledgeable about the characteristics and performance of materials and components integrated in the construction. This eliminates possible situations of delay which would have been caused by the non-availability of materials and also remedies the situation through informed substitution of materials and components.

2.2.4 Effective constructability review of design

Yates and Battersby (2003) suggest that designers must receive construction training prior to starting their design careers. This will aid the integration of construction experience into their designs for buildable designs. Designs should be reviewed to check for conformance with constructability. This process should be carried out at the design stage, so that the constructability count / rate of design is known before the contract is awarded. The process eliminates delay in project delivery.

2.2.5 Participation in site inspection and control

Effective participation in site inspection by parties involved in the project relative to their discipline is important. This process helps to discover the conformity of the construction to specifications and identify deviations. In this way errors are discovered early and are dealt with promptly.

2.2.6 Scope of site fabrication

The scope of off-site fabrication is an indication of the extent to which design could be easily constructed. A large scope of off-site fabrication is a likely indication of delays to the delivery of the project. Attributes such as fixing problems and delivery of prefabricated components to the site may constitute delay.

2.2.7 Complexity of off-site fabrication components

Arditi et al. (2002) declare that the probability of a problem occurring on a less complex project is low compared to a complex project. Complexity refers to the intricacy of construction and associated problems. Probable problems include design mistakes, poor quality and inaccuracy of dimensions. These associated problems may lead to delays in the delivery of the project. Trigunarsyah (2007) is of the opinion that constructability is enhanced when designs are simplified to enable efficient construction. This allows good planning of work and site layout.

2.2.8 Appropriateness of working space, its impact on smooth activity workflow and sequencing

Overcrowded work sites may cause conflicts in the work process, which may result in the decline of the effectiveness of operators. The lack of appropriate working space and congestion on the site can contribute to the slow progress of work.

2.2.9 Implications upon trade coordination

Congestion on site may lead to difficulty in the coordination of trades. During the process of planning work activities, mistakes might be made in the form of two different trade activities occurring simultaneously in the same work area with no space to work. This may lead to a delay in the project.

2.2.10 Appropriateness of design tolerances

Trigunarsyah (2007) posits that constructability will be enhanced when owner, designer, and constructor personnel review the construction specification in detail. The major factor to note during off-site fabrication is the provision of allowances for on-site fixing. In situations where the tolerance provided is not appropriate, two steps might be taken: re-fabrication or forging to allow for appropriateness. These two activities require time which is additional to the initial estimated period and may constitute delays when there is a large volume of such work. Arditi et al. (2002) suggest that faulty working drawings and incomplete specifications are the major constraints relative to constructability of designs.

2.2.11 Impact of materials storage and movement

Materials should be available when required in order to enhance production or maintain a constant production level. Storage for materials should be away from production points, but not too far. Interruptions of the smooth activity workflow and activity sequencing may negatively affect production levels when storage places are close to the production area. Activity sequencing is the particular arrangement of activities in such a way that the activities are executed chronologically without delay and the construction team can meet the completion deadline. When activities on a critical path of a project are disrupted, the project is bound to take longer than estimated to complete. Congestion on site is one factor that constrains adherence to activity sequencing. Sites should be well laid relative to movement of materials.

2.3 Quality of management during design

Project success is dependent on inter alia, the performance of the design team. Defective designs adversely impact on project performance and the participants and are responsible for many construction failures (Andi and Minato, 2003). Failure at the conceptual planning and design stages may lead to significant problems in successive stages of the project. Design inefficiencies could lead to redesign and rework or poor quality of products. Oyedele and Tham (2006) provide a listing of clients' ranking of designers' performance criteria among which were those that relate to quality of design coordination, smooth flow of work, vis-à-vis conflicting design information, timeliness of issuing of revised drawings, missing information, dimensional inaccuracies as well as delay of release of shop drawings.

2.3.1 Conflicting design information

Acharya et al. (2006) declare that ambiguous specifications are one of the six critical construction conflicting factors in the Korean context that affect project delivery time negatively. This refers to an item having double representation either in numerical value or in statement. For clarity and smooth flow of work, designs should be checked more than once before they reach the contractor. It is also advised that designs should be checked by the contractor for clarity and to avoid ambiguity upon receiving the award. If these exercises are not conducted, it may lead to delays.

2.3.2 Timeliness of issuing of revised drawings

According to Yakubu and Sun (2009), design change(s) is the most influential factor inhibiting the delivery of projects on time in the United Kingdom construction industry from the perspective of the contractor and the consultants. Walker and Shen (2002) declare that a delay

in design documentation was ranked the second most influencing factor that negatively affects project delivery. Time should not be wasted in the process of issuing revised drawings. The joint contract tribunal (JCT, 2005) specifies that revision of drawings should not take more than three days after which the contractor can claim for extension of time.

2.3.3 Missing information

Andi and Minato (2003) say that poor design and documentation quality negatively affect the construction process. Alaghbari et al. (2007) identify incomplete documents as one of the top ten factors causing delay in the delivery of projects in the Malaysian construction industry. Missing information interrupts the smooth flow of work. Contractors are employed to build in such a way that they adhere to design and specification. Assumptions should not be made while constructing, therefore missing information should be brought to the notice of the designer and a quick response should be given to address this.

2.3.4 Dimensional inaccuracies

Walker and Shen (2002) say that mistakes in design form part of the contractor-related factors which were ranked second in contributing to delays in the delivery of projects. Acharya et al. (2006) determined that design errors are one of the six critical construction conflicting factors in the Korean context. Dimensional inaccuracies are to be brought to the notice of designers and these should be resolved promptly, to avoid delays in the delivery of project. Joint Building Contract Committee (JBCC, 2000) clause 17.1.2 bestows the responsibility on the principal agent to issue the contractor instructions with regards to the rectification of discrepancies, errors in description or omission in contract documents other than this document.

2.3.5 Expediting shop drawings

Out of forty-four causes of delays identified by Faridi and El-sayegh (2006) in the United Arab Emirates, preparation and approval of drawings is the most influential. Delay in the release of shop drawings could affect speedy completion of work sections. Shop drawings should be delivered to the contractor whenever the need arises with no delays. Clause 32.5.1 of the JBCC states that the failure to issue or the late issue of a contract instruction following a request from the contractor entitles the contractor to claim for the expense in loss incurred, having notified the principal agent within forty working days from becoming aware or from when he / she ought reasonably to have become aware of such expense and loss.

3 Research Methodology

This section describes the procedure for data collection and the survey techniques used in the study. The study is titled influence of constructability and quality of management during design was undertaken to identify and assess factors influencing project delivery time. The study was conducted in Port Elizabeth in South Africa. The sample frame for the practitioners are: architects 1149 (SAIA); master builders 320 (MBA); clients 161 SAPOA); structural engineers 43 (CESA - East Cape), and quantity surveyors 473 (ASAQS). The sample consisted of industry practitioners who are: architects (9), master builders (18), quantity surveyors (23), and structural engineers (23), clients (12) and others (3).

Probability sampling technique was employed for sample selection, having calculated sample size based on the sample frame. Random sampling technique was employed for all professionals except the quantity surveyors and structural engineers. Systematic sampling techniques was used for the quantity surveyors, and for the structural engineers the entire sample, because they are few, based on the recommendation of Leedy and Omrod (2005). The study research instrument was a questionnaire survey, which was administered to respondents through post (Architects, MB, Structural engineers, and others) and e-mail (Quantity

Surveyors). These were received through the same means. Cronbach's coefficient test and validity test were performed and were found satisfactory. Cronbach's alpha of $\geq .97$ and factor loading of $>.60$ for samples sizes 85-89 were obtained.

A total of eighty-eight (88) questionnaires representing 6.1% response rate achievement recorded on questionnaire administration. Simple statistical tools such as mean score, percentages and so on were used for data analysis.

A five-point Likert scale adjoined with 'Unsure' and 'Does not' options was employed to analysis summated scores of the respondent's responses. Given that there are five points on the scale, and that $5 - 1 = 4$, the ranges were determined by dividing 4 by 5 which equates to 0.8. Consequently the ranges and their definitions are as follows:

- $> 4.20 \leq 5.00$ between a near major to major / major influence;
- $> 3.40 \leq 4.20$ between moderate influence to a near major / near major influence;
- $> 2.60 \leq 3.40$ between a near minor to moderate influence / moderate influence;
- $> 1.80 \leq 2.60$ between a minor to near minor influence / near minor influence, and
- $> 1.00 \leq 1.08$ between a minor to near minor influence.

Most of the respondents belong to the private sector (74%), their average working years is 17, and over the age of thirty (300). Respondents with Bachelor's degree 25% predominate, and respondents have handled not less than six (6) types of projects. Based on these, data can be deemed reliable.

4 Findings and Discussion

4.1 Constructability of design

Table 1. The influence of constructability factors on project delivery time

Factor	Response (%)					Mean score	Rank		
	Unsure	DN	Minor.....Major					
			1	2	3	4	5		
Participation in site inspection and control	3.8	2.5	1.3	7.5	18.8	27.5	38.8	3.86	1
Knowledge of performance of materials and components	4.7	1.2	3.5	10.5	18.6	38.4	23.3	3.62	2
Appropriateness of working space. Its impact on smooth activity workflow and sequencing	2.4	2.4	2.4	11.8	27.1	27.1	27.1	3.56	3
Effective constructability review of design	7.1	2.4	3.6	10.7	25.0	29.8	21.4	3.44	4
Impact of materials storage and movement	3.5	0.0	7.1	7.1	32.9	34.1	15.3	3.42	5
Implication upon trade co-ordinations	8.4	3.6	1.2	8.4	28.9	32.5	16.9	3.40	6
Appropriateness of design tolerances	7.1	1.2	6.0	15.5	21.4	34.5	14.3	3.29	7
Extent of modular dimensions in design	11.6	3.5	4.7	14.0	23.3	29.1	14.0	3.17	8
Complexity of off-site fabricated components	14.1	4.7	4.7	14.1	15.3	32.9	14.1	3.16	9
Scope of site fabrication	21.2	2.4	4.7	11.8	22.4	27.1	10.6	3.09	10
Extent of grouping simultaneous	12.9	3.5	4.7	11.8	32.9	24.7	9.4	3.05	11

Table 1 presents respondents' rating of the influence constructability of design factors have on project delivery time. It is observed that all factors in the category have MSs $> 2.60 \leq 3.40$, which indicates that these factors have between a near minor to moderate / moderate influence on project delivery time.

The most significant of these factors is the scope of site fabrication. One of the quickest ways of identification and correction of problems on site is the participation of the project team during site inspections. Owing to the large pool of knowledge available when the project team is involved in inspections, their wealth of experiences and knowledge provide a platform for immediate solutions to identified problems on site, and therefore engender processes that minimises or eliminate project delays.

The next factor is knowledge relative to the performance of materials and components. In the instance that a project manager or a contractor lacks adequate knowledge of material and component performance, it implies that when a material is not available for construction purposes the project will have to stop until such time that it would be available because alternatives cannot be suggested as a result of lack of knowledge of material performance.

The third most significant factor is the appropriateness of working space. When the space available on site to carry out construction tasks is limited, it adversely impacts the smooth flow of activities and reduces the number of activities that can be done at any time. Where the working space is adequate numerous activities can be carried out simultaneously, thereby increasing the rate of building. All of these factors agrees with Trigunarsyah (2004) stated factors for consideration during design and construction of a project relative to constructability issues.

The least significant factor in this category is the extent of grouping simultaneously. This factor is most effective relative to electrical installations. When comparing other sections of work with the impact this factor could have in speeding up work, it is negligible. Therefore, on the average, it could be deemed that it has a negligible effect on project delivery time.

4.2 Quality of management during design

Table 2. The influence of quality of management during design factors of project delivery time

Factor	Unsure	Response (%)					Mean score	Rank	
		DN	Minor.....Major						
			1	2	3	4			5
Conflicting design information	2.3	1.2	13.8	9.2	23.	24.	26.4	3.36	1
Missing information	1.2	2.3	11.6	15.1	25.6	20.9	23.3	3.22	2
Timeliness of revised drawings	8.1	1.2	14.0	12.8	23.3	21.0	19.8	3.17	3
Expediting shop drawings	5.8	4.7	14.0	18.6	18.6	29.1	9.3	2.84	4
Dimensional inaccuracies	2.3	3.5	20.9	12.8	32.6	11.3	16.3	2.78	5

Table 2 presents the respondents rating regarding the influence of quality of management during design, on project delivery time. All factors in this category have MSs $> 2.60 \leq 3.40$, which indicates that these factors have between a near minor to moderate / moderate influence on the project delivery time.

The factor that has the most significant influence in the category of quality of management during design is conflicting design information, this corroborates with Shehu and Endut, (2013) finding. The probable reason for this is the process it will take to correct a mistake. It may require checking the design from the beginning, which may take longer than expected. The second most significant factor is missing information. This factor also agrees with Chan and Kumaraswamy (1998) finding of waiting for information. This factor may lead to delays as a

result of carelessness or incompetence in design. Missing design information will inhibit the smooth flow of operations on site, therefore introducing delay to the scheduled project completion date.

The least significant factor in this category is dimensional inaccuracies. Although this factor is the least influential in this category, it does not imply that its effect is negligible because of the time it takes to clarify inaccuracies may result in delay in the delivery of the project.

5 Conclusion and Further Research

Conclusion to this study is in two parts, relative to influencing factors of constructability and quality of management during design on project delivery. With respect to influencing factors of constructability: that appropriateness of working space may negatively impact on the smooth activity workflow and sequencing, non-effective constructability review of design leads to revisions and time wastage, which negatively affects project delivery time, and materials shortage adversely affects project delivery.

Relative to influencing factors of quality of management during design, conflicting and missing information adversely affect project delivery time.

Based on the conclusion reached in this study, it is evident that the non-effective conduction of constructability reviews of design may lead to conflicting and missing of information, and inaccurate dimensional coordination of designs information, that could engender delay in the delivery of project. Therefore, it is suggested that the construction industry should provide quality management guidelines and should be enforced by consultant on projects. Stakeholders relative to design should be committed to quality management during designer. Designers' quality management should focus on the following:

- Committed to providing a quality service;
- Production of correct and complete drawings and specifications;
- Coordinating and checking of design documentation;
- Conducting design verification through design analysis reviews, and
- Conducting constructability reviews.

It is hereby recommended that further study be conducted on the extent of constructability reviews on design and quality of management during design

6 Acknowledgement

This paper is part of a Ph.D research that was conducted at the Nelson Mandela Metropolitan University, Port Elizabeth, South Africa in the year 2011. The support of the research and Postgraduate Support Unit of Durban University of Technology, Durban is gratefully acknowledge. This is with respect to the financial support given regarding the publication of this paper in a conference proceeding.

7 References

- Acharya, N.K., Lee, Y.D. and Im, H. M. (2006) Conflicting Factors in Construction Project: Korean Perspective. *Engineering, Construction and Architectural Management*, 13(6), 543-566.
- Alaghbari, W.; Razah, M.; Kadir, A; Salim, A., and Ernawati,. (2007) The Significant Factors Causing Delay of Building Construction Projects in Malaysia. *Engineering, Construction and Architectural Management*. 14 (2), 192-206.
- Andi and Minato, T. (2003) Representing Causal Mechanism of Defective Designs: A System Approach Considering Human Errors. *Journal of Construction Management*

- and Economics*, 21, 297-305
- Arditi, D; Sikangwan, P.; and Tokdemir, O. B. (2002) Scheduling System for High Rise Building Construction. *Construction Management and Economic*. 20(4), 353-364 (12)
- Assaf, S.A., Al-Khalil, M. and Al-Hazmi, M. (1995) Causes of Delay in Large Building Construction Projects. *ASCE Journal of Management in Engineering*, 11(2), 45-50
- Assaf, S.A. and Al-hejji, S. (2006) Causes of Delay in Large construction Projects. *International Journal of Project Management*, 24(7), 349-357
- Chan, D.W.M. and Kumaraswamy, M.M. (1997) An evaluation of construction time performance in the building industry. *Journal of Building and Environment*, 31(6), 569-578.
- Faridi, A.S. and El-Sayegh, S.M. (2006) Significant Factors Causing Delay in the UAE Construction Industry. *Journal of Construction Management and Economics*, 24, 1167-1176
- Kaming, P.F., Olomolaiye, P.O., Holt, G.D., and Harris, F.C. (1997) Factors Influencing Construction Time and Cost Overruns on Highrise Projects in Indonesia. *Journal of Construction Management and Economics*, 15(1), 83-94.
- Leedy, P. D. and Ormrod, J. E. (2005) *Practical Research: Planning and Design*. 8th Ed. New Jersey: Pearson Prentice Hall.
- Long, L.H., Lee, Y.D. and Lee, J. Y. (2008) Delay and Cost Overruns in Vietnam Large Construction Projects: A Comparison with Other Selected Countries. *Journal of Civil Engineering*, 12(6), 367-377.
- Mbamali, I., Aiyetan, A.O. and Kehinde, J.O. (2005) Building Design for Buildability: An Investigation into the Current Practice in Nigeria. "*Building and Environment V*" *South Africa*, 40, 1267-1274
- Niazai, G.A. and Gidado, K, (2012) Causes of Project Delay in the Construction Industry of Afghanistan. *3rd EPPM International Conference of Engineering, Project, and Production Management, Held on the 10 Sept. – 11 Sept. at the University of Brighton, UK*, 63-74.
- Ogunlana, S.O., Promkuntong, K. and Jearkjirm, V. (1996), "Construction Delays in Fast-growing Economy: Comparing Thailand with other Economies". *International Journal of Project Management*, 14(1), 37-45.
- Oyedele, L.O. and Tham, K.W. (2006) Clients' Assessment of Architects' Performance In Building Delivery process: Evidence from Nigeria. *Building and Environment*, 42(5), 2090-2099.
- Shehu, Z.; Endut, I.R., and Akintoye, A. (2014) Factors Contributing to Project Time and hence Cost Overrun in the Malaysian Construction Industry. *Journal of Financial Management of Project and Construction*, 19(1), 55-75.
- Trigunarsyah, B. (2007) Project Designers' Role in Improving Constructability of Indonesian Construction projects. *Journal of Construction Management and Economics Vol 25*: 207-215.
- Walker, D. H. T. and Shen, Y. J., 2002. Project Understanding, Planning, Flexibility of Management Action and Construction Time Performance: Two Australian Cases Studies. *Construction Management and Economics*, 20, 31-44.
- Yakubu, A. O. and Sun, M. (2009) Cost Time Control Construction Projects: A Survey of Contractors and Consultants in the United Kingdom (UK). *Construction Information Quarterly*, 11 (2), 52-59.
- Yates, J. K. and Battersby, L. C. (2003) Master Builder Project Delivery System and Designer Construction Knowledge. *Journal of Construction Engineering and*

Management, 129(6), 635-644.

WOMEN HEALTH AND SAFETY IN CONSTRUCTION INDUSTRY

Alewi, Monisola Florence; Talukhaba, Alfred Atango; Opaleye, Oladele Solomon
Department of building sciences, Faculty of Engineering and the built Environment, Tshwane University of Technology, Pretoria, Gauteng, South Africa

Abstract

The research investigates the impact of ergonomics on health and safety of women in the construction workplace. Increased participation of women in the construction industry has been observed over the century. However, recent trends reveal a decline in women participation in the construction industry. Women participation in the broader economy is associated with economic growth. The argument makes a strong case for an investigation into women health and safety status and its impact to the construction industry. A quantitative study was done to give the discussion a local perspective with the objective to assess the impact of materials and tools handling over the health and safety status of women. The study surveyed a representative sample of 60 women found in 11 construction sites in Klerksdorp. Descriptive and inferential statistical tools were employed using the SPSS program to analyze the data and reach the study's conclusion. The research found that the women construction workforce is unhealthy and significant influence poor work ergonomics. The status quo impedes women's participation in the construction industry worsening the outcomes of poverty, unemployment and inequalities. The study concludes that health and safety education (HSE) programs need revamping to focus on long term goals that reduce health and safety outcomes for women. Progress made on tools and construction equipment design to improve work ergonomics has a limited impact without relevant HSE programs in place.

Keywords: Construction, Ergonomics, Health and Safety, Women, Workforce

1 Introduction

Ergonomics of the construction sector invokes the notion that construction work demand must not exceed the capacity of workers. Exceeding the capacity of workers has negative consequences for the health and safety of the workers. The negative consequences are severe particularly for women construction workers whose social burden is higher in the South African social context where 62% of households are women ran (Statistics South Africa (2014)). This study investigates the effects of health and safety of women in construction industry. The global participation of women in the construction sector over the century has been observed to have risen according to U.S Bureau of Labour Statistics (2012) and locally confirmed by the South African Statistics of labour (2014). The increased participation of women construction workers in the construction sector and economies has also been linked to the economic progress of countries (IMF, 2010). However current global and local trends do show a decrease in the participation of women (Plascon, 2012). Part of the change in trends is explainable through the recent global recession and the post-world cup decline of the construction sector of South Africa. Empirical evidence suggests that a significant part of the decline in women construction

worker participation is also linked to bad ergonomics and the subsequent poor health and safety outcomes. OICI (2003) argued that construction work demands tremendous physical input to do the job. Schneider & Susi (1994) had also proffered that construction work is problematic for ergonomics as it involves handling of materials and tools which may not be suited for women.

Furthermore, the construction sector in South Africa is going through a recovery (Plascon, 2012). If this recovery is to be deepened towards economic inclusivity, ergonomics of the construction workplace particularly for women must be actively managed to obtain positive outcomes of health and safety. IMF (2012) associates women participation in the economy to the economic growth of a country. South Africa has launched the national blueprint National Development Plan (NDP2030) which hinges its success on the attainment of inclusive economic growth. The findings of this study would aid the efforts. This studies hypothesized that active management of the impact of construction workplace ergonomics positively influences women participation and subsequent productivity. Productivity and participation of women in the construction sector has positive outcomes for the economic growth of the country and in turn better outcomes of poverty, unemployment and inequalities.

2 Literature Review

Construction work is a problem for women as it involves handling of materials and tools which may not be suited for women (Schneider and Susi, 1994). According to Gibbons and Hacker, (1999) numerous construction tasks pose significant ergonomic risks to women workers. According to Safety and Health (2002), in 1999 the Bureau of Labor Statistics Advisory Construction Committee on Safety and Health found productive hazards ,ergonomic concerns, lack of adequate sanitary facilities, hostile workplace culture and ill-fitting personal protective equipment (PPE) and clothing as compassing issues in construction sector for women.

Kaminskas and Antanaitis, (2010) argue further that the high physical work demands are considered the primary risk factor for work-related injury disorders. In particular, the manual handling of materials in different awkward postures increases the risk of women injury disorders (Marras, 2000). Injury disorders cause sickness and decreased work capacity, thereby increasing the costs for trade site and interfering in social security systems on a national scale. Worldwide, the prevalence of muscle and tissue injury symptoms involving one or more body regions and occupational injuries among women bricklayers and bricklayers' assistants is higher than it is among construction workers in general. Interventions into the physical work demands placed on these workers are necessary in order to reduce the risk of injury disorders (Goldsheyder, 2002, Chau, 2004 & Rwamamara, 2006).

Recent studies had shown that to reduce work-related muscle and tissue disorders, tools, materials, and equipment should be designed based in part on ergonomic considerations (Schneider,1994).Tools and equipment are often designed to be used by normal sized men. Do not make hand tools for women, and women have different sizes, just like men (Morse & Hinds, 2000). OSHA, (1999), noted that designing equipment and tools to help women work more effectively can improve the health and safety of both men and women in construction workplace and points to the invention of a tool to lift manhole covers as one illustration of this. For women it was really difficult to lift them, but it was also very physically challenging for men. In this case, if we are concentrating on protecting women, we are also securing the entire construction workplace (NSC, 2010).

Women's size and body require reconsideration of methods for lifting and handling material. Not only that woman come in all sizes and with various degrees of muscular strength, but their pelvic structure is different and their Centre of gravity is lower than men's. This would impact jobs that require standing at a work station. Lower equipment handles would facilitate

the use of body weight in pushing and pulling jobs. Women's muscular strength is more equal to men's in their legs. Women will have more equal footing with men if the work load could be moved downward, with less confidence on the strength of hands and arms (OSHA, 1999). Women tend to have less upper body strength than men; they cannot use all of the methods men use for lifting and handling material. Out of necessity, construction women have to develop ways that make the job possible and safer for a woman. Personal protective equipment is intended to protect workers from hazards on the job. But PPE cannot perform normally if it does not fit properly. According to the 1999 report of OSHA's Health and Safety of Women in Construction workgroup and the Advisory Committee on Construction Safety and Health, ill-fitting PPE was a major problem for women in construction workplace. As surveyed and reported on PPE, women in construction used to wear multiple pairs of socks to fit into work boots designed for men, and women also used to roll up sleeves and hind legs on overly large protective clothing. Ever since 1999 report of OSHA's, the issue of properly fitting personal protective equipment has been generally acknowledged (NSC, 2014).

Ergonomic risk factors are characteristics of a job that facilitate ergonomics stress on the body (Miosha, 2010). Risk factors occur at different jobs and tasks. The more women are exposed to these risk factors the greater the probability of ergonomics injury and what is called work related musculoskeletal disorders. According to Hagberg et al. (1995), ergonomics and human factors are often used interchangeably in workplaces. Both describe the interaction between the worker and the job demands. The difference between them is ergonomics focuses on how work affects workers, and human factors emphasize designs that reduce the potential for human error. Bongers et al. (2002) stress that by addressing traditional and environmental risk factors, it can keep workers injury free. Risk factors are defined as actions or conditions that increase the likelihood of injury to the musculoskeletal system. Applied ergonomics literature recognizes a small set of common physical risk factors across many occupations and work settings. The relationship between risk factor exposures and the level of musculoskeletal injury risk is not easily defined. Although physical risk factors are important first-line risk factors, there are other plausible factors such as organizational and psychosocial factors that may provoke a disorder or indirectly influence the effect of physical risk factors (Bongers et al., 2002).

Bongers and Kremer (2002) went on to identify the three categories of risk factors as biomechanical exposures, psychosocial stressors and individual risk factors. Biomechanical exposures include factors such as poorly designed workplaces and biomechanical exposures such as repetitive motion, high forces and deviations from neutral body alignments (National Research Council & the Institute of Medicine, 2001). Psychosocial stressors at work include factors such as high-perceived workplaces stress, low-perceived social support, low perceived job control, and time pressure (Bongers and Kremer, 2002; Huang et al., 2003). Individual factors include gender (female), age, negative stress reactions-especially stomach reactions, and unsatisfactory leisure time and/or additional domestic workload.

Williams and Wiehagen (2004), argue that although the causes of any particular case of a MSD are exceedingly difficult to identify with complete accuracy, certain risk factors are typically discussed in the field of ergonomic studies. Musculoskeletal disorder is a condition or disorder that involves the muscles, nerves, tendons, ligaments, joints, cartilage, or spinal discs. These disorders are not typically the result of a distinctive, singular event, but are more gradual in their development. Thus, MSDs are cumulative-type injuries. It is essential to understand just what a risk factor is, or what is not. A risk factor itself is not necessarily a causation factor for any particular MSD. Many times it is not simply the presence of a risk factor, but the degree to which the risk factor is expressed that may lead to MSD. Similarly, to the extent a MSD case is attributable to a risk factor, often it will be a combination of multiple risk factors, rather than

any single factor, which contributes to or causes an MSD. The next section discusses the methodology adopted to investigate the effects of the health and safety outcomes to the construction industry in the context of this study.

3 Research Methodology

Data was collected from a sample of 60 women construction workers around construction sites found in the Klerksdorp town. Questionnaires were administered to willing participants. Response rate was maintained at 100% as the sampling design was designed to continuously visit construction sites until 60 willing participants were reached as the targeted sample. However, the researcher recorded all attempted and failed access to sites in addition to sites that did not have women these had implications on the study. The implication on the study is apparent 5 sites out of 11 sites visited had no women as construction workers: suggesting a significant strained women participation in the construction sector. The data collected were tabulated into SPSS and analysed. The likert scaled questions were checked for internal consistence using the Cronbach's alpha analysis.

The questionnaire was divided into three sections. One section is for the demographic data of the sample. The other two sections profiling the workplace ergonomics of the sample proceeded from the anchor questions that sought to establish the health and safety status of the sample prior to joining the construction sector and after engaging with the tasks of the construction workplace. The analysis work sought to establish whether the health and safety outcomes had substantial linkages with workplace ergonomics of the sample and what statistical conclusions regards the participation and productivity of women can be made between the ergonomics profiles and the health and safety outcomes. In the process reveal the impact of ergonomics on the sample.

4 Data collection

The data obtained in this research is based on the primary sources as well as secondary Sources. Primary sources includes sampled women construction worker participants were the survey questions collected data on the impact of ergonomics on their health and safety, their attitude towards the contribution of their work environment to the problems. Primary data was sourced from the field of study through structured interviews. This study employed the interview technique, specifically the structured interview technique. A questionnaire was designed incorporating a mix of structured questions, open ended questions as well as in depth analysis questions. These were filled in by the interviewer with the information obtained from the face to face interviews with the participants from targeted construction sites. Additionally the researcher was able to observe and record site specific data concerning the working environment for women working at the construction site. Secondary sources of data include the monetary and the fiscal policy statements from the Reserve Bank of South Africa and the Ministry of Finance respectively. The qualitative interviews also favour the explanatory and the exploratory research approaches which aided data collection. These interviews were completed in a space of three months.

Each interview took on average 20minutes. Responses were directly recorded on questionnaire through a local language interpreter. Each response was read backward for verification and confirmation of the responses given.

5 Summary and Research Findings

5.1 Demographics information

Age distribution was an important consideration as a crude indicator of women construction workers participation in current recovery. Any evening out of the age groups across the sample

would suggest continued participation and inclusion of women in the construction sector. The age groups that are dominant can also suggest changes and the period when these changes took place. The 45 to 54 year age group represented majority of the sample women participants. The age distribution shows the impact of the World Cup and the preceding contraction. The generation that benefitted from the construction boom was more likely to be in this age group having joined as 34 year olds and less. The 25-34 age groups joined the construction sector during the depression but only the minority of the boom time employment for the same age group. The 11.4% composition in the random sample represents a 36% of the boom time employment of women in the construction sector may signal the recovery which is underway. These statistics can be enhanced to demonstrate the elasticity of women employment in the construction sector as the economies move from boom times to deeps. The 14% composition of the 25 to less age represents a possible 8% current recovery in the participation of women in the construction sector.

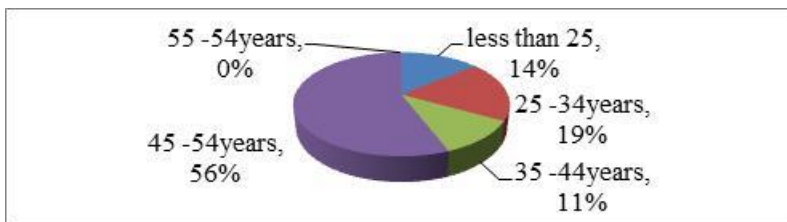


Figure 1. Age distribution

5.2 Health and safety outcomes

The impact of ergonomics of the construction workplace is apparent in the massive shift of health outcomes from the point of employment up to the point of the field work of this study. Only 10% of the sample participants were nursing different illnesses under investigation in this study at the point of their employment in the construction sector.



Figure 2. Health status at employment

At the point of the field study 72% had joined in with new illnesses with higher chance of having getting these illnesses from the ergonomics of the construction workplace.

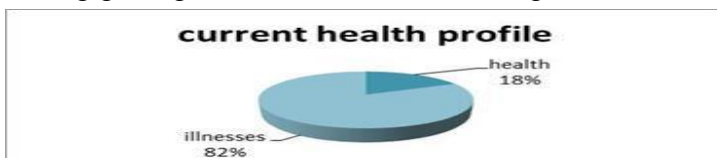


Figure 3. Current health profile

From a safety outcomes point view 56% of participants had been involved in some accident of some sort leaving them with different illnesses. For those who were involved in accidents none had been involved in similar accidents prior to joining the construction sectors.



Figure 4. Safety profile

If the impact of confounding factors such as aging and other diseases are factored in the figure is still excessive pointing to an unhealthy women construction workforce. These outcomes have a direct negative impact on women participation and subsequent productivity in the sector. The outcome partly explains why 5 out of 10 construction sites had no women employee. Negative health and safety outcomes amongst women employees of the construction sector are also driven by poor ergonomics according to literature. The literature review process for the study identified ergonomics risks in working postures, work surfaces, tools and equipment. These risks manifest in employees picking up ailments in different parts of their body depending on their assigned tasks. Active management of ergonomics by the employee, the construction company and any other stakeholder is paramount to the arrest of the negative effects for this socially important and burdened demographical group. The ergonomics profiles for the sample where investigated as follows:

5.3 Working Surface Causing Injuries

Participants mostly felt safe working on the ground as shown by a skew of the responses; to the left. The roof top was also considered safer with responses skewed to the left. The respondents were unanimous in the identification of risks with working on stair cases, scaffolds and on construction ladders. The study adds percentages from the sometimes vote, the often vote and the always vote, to give the risk factor for a particular working surface. This is illustrated below:

$$\text{Sometimes } 1/2 (\%) + \text{often } (\%) + \text{always } (\%) = \text{Discomfort factor } ()$$

$$\text{Never } (\%) + \text{Seldom } (\%) + \text{sometime } 1/2 (\%) = \text{comfort factor } ()$$

$$\text{Ergonomic Risk factor} = \text{decision between } (-) \text{ risk factor \& comfort factor}$$

Table 1. Working surface

	Discomfort factor	Comfort factor	Ergonomic risk factor
Stairs	$\frac{1}{2}(.10) + .267 + .55 = .867$	$.4 + .07 + \frac{1}{2}(.12) = .013$	-.867
Ground	.3255	.6745	.6745
Ladder	.8745	.1255	-.8745
Scaffold	.767	.233	-.767
Roof	.3745	.6255	.6255
Perfect discomfort(-5)	-3.2085(-64.17%)		-1.209 (-24%)
Perfect comfort(5)		1.7915(35.83%)	
deviation			2.66

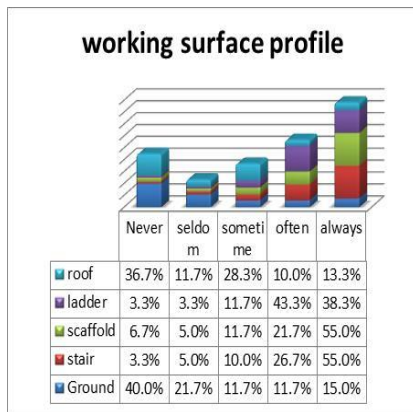


Figure 5. Working surface

The samples show a higher discomfort factor for an exhaustive list of the surfaces that women work in the construction sector. The findings show that 64% of the women were uncomfortable and at risk of either getting an injury or illnesses associated on this basic working surface with a 2.66 deviation on the downside. Six women construction workers in every ten were likely to come off worse by simply engaging in their daily tasks which involves working on the ground, the roof, stairs, scaffolds and construction ladders. The outcome puts pressure on women participation in the construction sector and subsequently negatively affects their productivity. This is further highlighted by the finding that out of the targeted sites 46% of the sites did not employ women. If out of 10 women construction workers 9 are going to end up with some ailment of some sort this place a dumper on the overall productivity in the sector and employers are likely to hold back on employing women. The recovery in the construction sector, therefore, risks the exclusion of women and may not result into an inclusive economic growth for South Africa.

5.4 Working Postures

The common work postures profile confirms a finding that identifies awkward postures, reaching away, lifting/bending, twisting/pulling, kneeling/holding and standing as the common risk factors for ergonomics in the construction work. The sample, however, reflects twisting and pulling not being part of the common task assigned to these women construction workers. The sample shows an almost perfect discomfort of 80.5% with the different postures required to complete the construction work tasks.

Table 2. Working posture

	Discomfort factor	Comfort factor	Ergonomic risk factor
Awkwar posture	$\frac{1}{2}(.333)+.25+25=.6665$	$.05+.083+1/2(.333)=.3335$	-.6665
Reaching Away	-.7165	.2835	-.7165
Lifting/bending	-.8335	.1665	-.8335
Twisting/ pulling	-.8415	.1585	-.8415
Kneeling/holding	-.7995	.2005	-.7995
standing	-.975	.025	-.975
Perfect discomfo(-6)	-4.8325(-80.5%)		-4.8325(-80.5%)
	Perfect comfort(6)		
		1.1675(19.6%)	
deviation			0.06

5.5 Women Construction Worker Opinions

There is a lack of consensus in the data in terms of whether these employees believe that tools, materials and equipment expose them to risks on their work places. An agreement factor of 57.5% does not put a convincing agreement amongst the sample participants as to the effect of these risk factors to their ergonomics. Most were neutral (undecided) as revealed by the tower in the middle. This outcome means the sample members had not been adequately educated so as to engage with their environment from a point of knowledge. Active management and engagement with the ergonomics risk factors in construction workplace has been found to cause a reduction in outcomes of health and safety. The finding went against literature findings that had proffered that the design of tools and equipment were heavily contributory the negative outcomes in the ergonomics of the construction workplace.

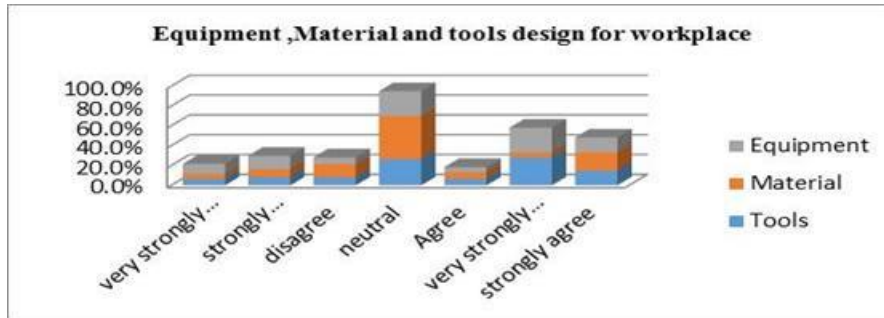


Figure 6. Equipment, material and tools

5.6 Common Tools causing Injuries

The data on common tools causing injuries shows a left skew on the responses suggesting that respondents do not find tools as causing harm to their health and safety. The problem with their workplace ergonomics is probably somewhere else. Crudely, the data suggests and confirms progress in the design of tools to actively manage ergonomics at the workplace. If such an outcome is held true attention then centres on ability of the workers to use the tools ergonomically. Tools recorded a comfort factor of 76.5% with a 0.01 deviation.

Table 3. Tools causing injuries

	Discomfort factor	Comfort factor	Ergonomic risk factor
Hammer/nail	$\frac{1}{2}(.25)+.1+.83=-.309$	$.283+.283+1/2(.25)=.691$	-.691
Pliers/screw driver	.2585	.7415	.7415
Hand saw/ hand drills	-.2085	.7915	.7015
Shovel/mixers	-.192	.808	-.808
Chisels/ trowel	-.2085	.7915	.7915
Perfect discomfo(-5)	-1.177(-23.53%)		3.8235 (76.5%)
Perfect comfort(5)		3.8235(76.5%)	
deviation			0.01

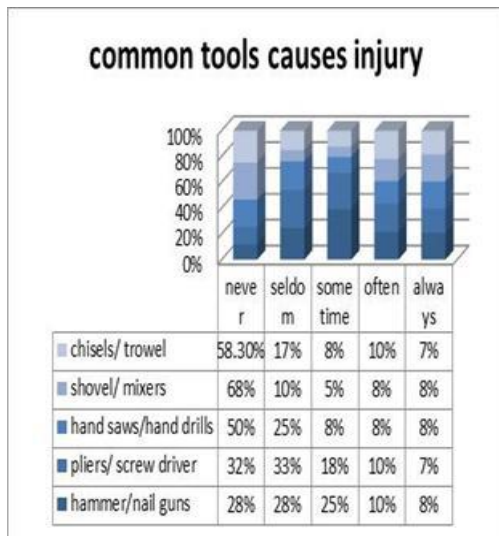


Figure 7. Tools causing injuries

5.7 Areas of Common Injury

Distribution of responses on the common types of injuries show a decisive right skew in line with literature findings that identified sprain/strain, neck/shoulder/back, hand/wrist and knee/foot/ankle as the common types of injuries arising from poor ergonomics of the construction workplace. An agree factor of 60% is decisive that these injuries are prevalent and still pose significant risks for their sample in the ergonomics of their workplace.

Table 4. Areas of common injury

	Discomfort factor	Comfort factor	Ergonomic risk factor
Sprain/ strain	$\frac{1}{2}(.267)+.20+.167=-.5005$	$.117+.25+1/2(.267)=.4995$	-.5005
Neck/back	-.2665	.7335	.7335
Hand/wrist	-.3755	.6245	-.575
Knee/foot/Ankle	-.459	.541	-.541
Perfect discomfo(-4)	-.16015(-40%)		-1.209 (-24%)
Perfect comfort(4)		2.3985(60%)	
deviation			0.9568

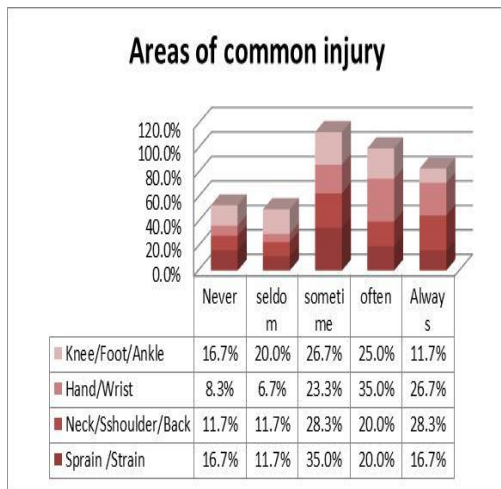


Figure 8. Areas of common injury

5.7 Construction Equipment causing injury

As confirmation of prior findings that participants do not find the design and their interaction with construction equipment in handling materials as resulting in significant risks for their health and safety, a 0.96 deviation and a decisive left skew with a higher (71.9%) disagree factor is found. While this result maybe evidence for progress in the design of the equipment for good ergonomics of the construction workplace, the higher outcomes for health and safety for the sample is still suggestive of problems regardless.

Table 5. Construction Equipment

	Discomfort factor	Comfort factor	Ergonomic risk factor
Crane	$\frac{1}{2}(.172)+.18+.57=-.0.836$	$.067+.11+1/2(.172)=.164$	-0.836
Concrete pump	-.7915	.2085	.7915
Wheel loader	-.808	.192	-.808
Scaffolding/dumper	-.459	.541	-.541
Concrete mixer	-.7	.3	-.7
Perfect discomfort (-4)	-3.5945(-71.9%)		-1.349 (-33.7%)
Perfect comfort(4)		2.3985(28.1%)	
deviation			0.96

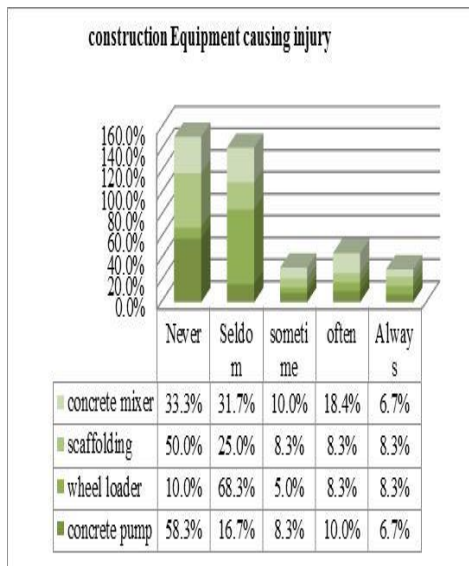


Figure 9. Construction equipment

6 Conclusion and Further Research

The study concludes that material handling in the construction sector still pose significant risks for women construction workers. The risks are having a negative influence on their productivity in the construction sector hence their participation has stayed very low. The findings are not consistent with a developing inclusive economy or a deep recovery in the construction sector. A divergent outcome for women and men emerges particularly when the sector is faced with headwinds. Women construction workers are far more severely affected by problems in the construction sector than their male counterparts. The situation is making a negative contribution to the social ills of poverty, unemployment and inequalities among women who seem to carry a larger social burden.

Sector wide efforts to curb the effects of material handling on women ergonomics include tools and equipment design, safety and health education and awareness programs to ensure active management of ergonomics. The study concludes that the design of tools and equipment is running in the right direction. HSE programs have, however, waned in their efficacy and require reinvestment and refocusing to target longer term objectives which secures participation and productivity for women in the construction sector. Without these programs coming on board to complement efforts elsewhere, the risks for women remain and the long term outcomes on women productivity and participation remain depressed to positively influence the economy and society.

The implications of these findings are that the inclusivity of the construction sector greatly impacts the inclusivity of the national economy. The construction sector contributes about 10% of the national GDP (Plascon, 2012). Current recovery in the construction sector runs the risk of excluding women construction workers if the negative impact of materials handling on work ergonomics for women workers are not actively managed to significantly reduce the associated risks. New and emerging construction companies must be convinced and even incentivized to make HSE investments. The sample could be enlarged and extended to increase the study's utility. The impact of ergonomics on the health and safety of women construction workers would be better concluded on from the viewpoint of men construction workers, construction sector management and the women construction sector to give balance and rigor to the study. Future studies could be enhanced to investigate these key players as well by:

1. Enlarging the representation made in the study such that it could be generalized over the whole construction sector in South Africa under reasonable error margins.

2. The impact of ergonomics on the health and safety of women construction workers would be better concluded on from the viewpoint of men construction workers, construction sector management and the women construction sector to give balance and rigor to the study. Future studies could be enhanced to investigate these key players as well.
3. Further investigations maybe conducted to find the discrepancies between men and women on their exposure to accidents and the equipment putting them at risk of accidents.
4. The study could be enhanced by recording the number of HSE programs these workers were exposed to and investigating the relationship between health and safety impact and number of HSE programs attended.
5. This conclusion can be enhanced by removing any confounding factors in the women construction workers varying lifestyles but what the study finds is still catastrophic especially if generalized on the population of women construction workers in the country.

7 References

- Jaffar, N., H, a. -t., Mohd- Kamar, I. F., and Lop, N. S. (2011). A literature review of ergonomics risk factors in construction industry. *The 2nd international building control conference*. www.sciencedirect.com.
- James, T. A. (2007). ergonomics for construction workers. *National institute for safety and health (NIOSH)*.
- Plascon (2012). *The state of the South African construction Industry*. Gauteng: industry - insight-2nd quarter.
- Schneider, S and Susi, P. (1994). Ergonomics and construction: A reveiw of potential hazards in new construction. *American Industrial Hygiene Association Journal*. , 55 (7), 635-649.
- US, BLS. (2012). Ergonomics Challenges for women construction workers. *Bureau of Labour Statistics, United States Department of Labour*.
- William, S., and Marras, W.K. (2003). Ergonomics working for cement and concrete construction labourers. *Occupational and Industrial Orthopaedic Centre (OIOC).2003*.
- The Occupational and Industrial Orthopaedic centre .(2003), NYU Hospital for Joint Diseases Orthopaedic Institute and Graduate Program in Ergonomics and Biomechanics 2003, ergonomics working for Heavy and Highway Construction Labourers.
- IMF (2010). *World Economic outlook: a survey by the International Monetary Fund*. Washington, DC: IMF.
- Statistics, S. A. (2012; 2014). *Quarterly Labour Force Survey*. Pretoria.
- Creamer, M. (2015). *Construction 2015: A review of South Africa construction sector*, South Africa.
- Bongers, M. P.; Kremer, A.; and Ter Laak, J (2002). Are psychosocial factors risk factors for symtoms and signs of the shoulder, elbow or hand/wrist? *A review of the epidemiological literature. American Journal of Industrial Medicine*, 41 (5), 315-342.
- Gibbons, B. and Hecker, S. (1999). Participatory approach to ergonomic risk reduction: case study of body harnesses for concrete work. . *Second International conference of CIB working commission W99 Implementation of safety and health on construction sites*, (pp. 373-380). Honolulu, Hawaii.

- Hagberg, M. B., Silverstein, R., Wells, J., Smith, M. ., Hendrick, P., and Carayon, J. (1995). Work related muskelosketal disorders (WMSDs). *Taylor and Francis, Inc.*
- Huang, G., Feuerstan, M. J., Kop, W. K., Schor, and Arroya, F. (2003). Individual and work organisation factors in work-related musculoskeletal symptoms. *American Journal of Industrial Medicine*, (43), 495-506.
- Miosha. (2010). MIOSHA fact sheet construction safety and health division. *Ergonomics in construction*.
- Occupational safety and health Administration (OSHA) (1999). Women in the construction workplaces: providing equitable safety and health protection . *Advisory Committee on construction safety and health (ACCSH)*. Department of labour: OSHA.
- Occupational safety and health Administration (OSHA) (1999). Women in the construction workplace . *providing equitable safety and health protection*.
- Occupational safety and health Administration (OSHA) (2010). Protecting workers from Effects of heat (Extreme temperature). [http:// www.osha.gov](http://www.osha.gov), *OSHA fact sheet*.
- Rani, M. R. (2003). Managing ergonomics risk factors at workplace. *Paper presented at NIOSH 6TH National Conference and Exhibition on Occupational Safety and Health*,. Sunway, Pyramid Convention Centre, Petaling Jaya, Malaysia.: NIOSH.
- William, J., Wiehagen, T., and Fred, C. (2004). *Ergonomics assessment of muskelosketal risk factors art Four Mines States*. Underground Coal, Surface Copper, Surface phosphate and underground limestone.

EVALUATION OF HEALTH AND SAFETY PLANNING PROCESS ON CONSTRUCTION SITES IN KADUNA METROPOLIS, NIGERIA

Jimoh, Richard Ajayi

Department of Building, School of Environmental Technology, Federal University of Technology Minna, Minna, Nigeria

Windapo, Abimbola Olukemi

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, Western Cape, South Africa

Omotayo, Omolara Shade

Department of Building, School of Environmental Technology, Federal University of Technology Minna, Minna, Nigeria

Abstract

Workers are exposed to new hazards due to the changing nature of construction projects. When an integrated approach of good safety planning process is adopted accidents are prevented and the outcome is an assurance that the project delivery process will be safe. Hence, this paper evaluates the health and safety (H&S) planning process on active construction sites in Kaduna Metropolis, Nigeria. A survey research approach was used in the study. Forty-two active construction sites were visited for both the self-administration of structured questionnaires and personal observations. The study found that respondents considered factors such as the positioning of the access roads, the type of the project, the location of the project to highly influence health and safety planning at the pre-tender stage. In addition, the study revealed that out of the 11 parameters measured to know the extent of health and safety planning put in place before the construction stage, eight can be deemed to support health and safety representative at management level. Based on the findings, it can be deduced that although all the factors affecting H&S are considered at the planning stage and H&S practices are highly applied on projects by the firms studied, high levels of accidents are still reported on construction sites. Further research is therefore required to match the frequency of accidents to factors considered and H&S practices applied during the project planning phase, to see whether significant results would be obtained.

Keywords: Accident, Construction sites, Health and Safety, Kaduna-Nigeria, Planning

1 Introduction

Construction workers lose their lives while others are injured on construction sites on an annual basis. Accidents happen daily which give rise to increase in death rate; in the year 2005, there were 4.2 million on the job non-fatal injuries and 5,702 fatalities recorded in the United States alone (Bureau of Labour Statistics, 2006; Bureau of Labour Statistics, n.d). The construction industry is known to be one of the riskiest industries in most countries (Edmonds and Nicholas, 2002). The fatalities recorded in developing countries such as Nigeria (see Windapo and Jegede, 2013) are worse than what exists in more developed countries due to lack of concern,

precise records, inadequate planning and legal regulations on health and safety. Onyejeji (cited in Adeogun and Okafor, 2013) asserts that Nigeria lacks legal regulations on health and safety and that those regulations that serve as reference point are the British ones. This has however changed with the introduction of National Building Code in 2006; it should be noted that the adoption of this Code by the States in Nigeria has been very slow.

A report by the International Labour Organisation (ILO, 1999) states that contributing to the high rate of accidents are those characteristics of the construction industry, which distinguishes it from the rest of the manufacturing sector. These are: the number of small firms and of self-employed workers; the variety and comparatively short life of construction sites; the migrant nature of the workers leading to high turnover; and the vagaries of the weather. Others include a badly planned and untidy site, which is the underlying cause of many accidents resulting from falls of material and collisions between workers and plant or equipment.

Planning aims to lay down the direction in which a move is made forward taking into account the resources that are available. Planning used in the construction industry is varied and considerable e.g. policy planning, pre-tender planning, pre-contract planning and contract planning. Health and safety planning is found in all of these planning types. Health and safety planning according to Saurin *et al.* (2003) is *sine qua non* to the requirements in safety regulations and standards. In a related development Okongwu (2010) stated that when an integrated approach of good production planning and accidents preventive mechanism is adopted, the outcome is quality assurance of the project delivery process.

Cooke and William (2009) stated that without adequate planning, it would be difficult to envisage the successful completion of any project. The following are the reasons for planning: to set a realistic time framework for the project; to establish realistic standards and avoid wishful thinking; to aid control during the project; and to review progress and take action when necessary to correct the situation.

According to Burke (2010) a change in one parameter may change other parameters as planning process not only establishes what is to be done, but also smoothens the way to make it happen. To this extent, planning asks questions, encourages participation, creates awareness, prompt action, solves problems and formalizes decisions based on consensus. Alhajeri (2011) posits that improvement can be made on health and safety by seeking to address construction problems in many different ways as long as it interrogates the crux of the research efforts in health and safety in construction. The Malta Occupational Health and Safety Authority (2006) report that many accidents in the construction industry are due to bad planning lack of organization and poor co-ordination on construction sites.

In a related study, Laufer *et al.* (1993) points out that the planning process is an area that limited research has been carried out unlike planning tools and techniques; twenty-two (22) years on, has anything changed? It is with this in mind that this study evaluates the health and safety planning process on construction sites in Kaduna Metropolis of Nigeria towards understanding the health and safety practices on projects. Answers were sought to the following research questions:

- What are the factors considered during the pre-tender stage planning for health and safety?
- What is the extent of health and safety issues put in place during planning at the construction stage?

2 Health and Safety Planning Process Stages

Health and safety planning process can be looked at from three interrelated stages.

2.1 Pre-tender Stage Planning for Health and Safety

Site Safe (1999) states that pre-tender stage plan contains information about the health and safety hazards of the project that will have to be managed during the work. The purpose of this plan is: to bring germane health and safety matters of design to the notice of those that are directly concerned and to ensure that contractors tendering have adequate knowledge of the project's health, safety and welfare requirements.

Health and safety planning is largely dependent on the nature, scope and complexity of the project to be undertaken. In spite of this, answers will still have to be sought to the following questions during pre-tendering health and safety planning (Site Safe, 1999): What is the nature of the project in terms of location, the type of construction etc.? What is the site location and local environment like? Are there any existing drawings and what is the importance of the drawings in relation to the project? What is the extent of information that is available on hazards that are difficult to avoid? Will clients own activities disrupt the free flow of work during the project especially if the project is to take place within the client's environment?

2.2 Areas to be Checked and Action to be taken during Pre-construction Stage Planning for Health and Safety

According to Mulinge (2014), construction health and safety management deals with actions that managers at all levels can take to create an organizational setting in which workers will be trained and motivated to perform safe and productive construction work. Prior to the commencement of work, the following are to be in place in order to reduce the occurrence of accidents to their minimum. Primary factors considered during the preconstruction stage planning for H&S are location of the project; type of project (scope – high rise/low rise); complexity of the project; the local environment; design information available, relevant to H&S; client needs; and site access routes (see Table 2). In addition, the following provisions are made:

2.2.1 Personal Protective Clothing (PPE)

Occupational Safety and Health Administration (OSHA, 2007) requires the use of personal protective equipment (PPE) to reduce employee exposure to hazards when engineering and administrative controls are not feasible or effective in reducing these exposures to acceptable levels. If PPE is to be used, a PPE programme should be implemented.

2.2.2 First aid kits

Construction sites are dangerous places, and first aid and rescue equipment should always be available. What is needed depends on the size of the site and the numbers employed, but there should be a blanket and a stretcher. On large sites with more than 200 people are employed, there should be a properly equipped first aid room.

2.2.3 Safety warning signs

Safety signs and signals are one of the main means of communicating health and safety information. This includes the use of illuminated signs, hand and acoustic signals (e.g. fire alarms), spoken communication and the marking of pipe work containing dangerous substances. If too many signs are placed together there is a danger of confusion or of important information being overlooked (Health & Safety Executive HSE, 2009).

2.2.4 Safety training

Occupational Health and Safety training consists of instruction in hazard recognition and control measures, learning safe work practices and proper use of personal protective equipment, and acquiring knowledge of emergency procedures and preventive actions.

2.2.5 Safety audits

Safety audits are used for gauging the extent to which an organization's policies and procedures are being followed and how they might be improved. They provide the organization with feedback, which enables the organization to maintain, reinforce and develop its ability to manage and reduce risks.

2.2.6 Safety policy

Hassanein and Hann (2007) established that construction site accidents are more likely to occur when there are poor company policies. The health and safety policy affirmation must incorporate the aims, which are not quantifiable, and objectives, which are quantifiable of the organization. Construction safety policy therefore is something that must be developed by each site manager and operating company prior to starting construction on site.

2.2.7 Site meeting

Site meetings are used for sensitizing workers on health and safety procedures on site and should therefore be held frequently. The absence of site meetings implies that workers are not given a forum to learn about various risks on the sites and supervisors equally do not have opportunities to communicate important health and safety matters to the workers.

2.3 The Construction Stage Site-Specific Planning for Health and Safety

This entails the process of setting out the arrangements for securing the health and safety of everyone carrying out the work and all others who may be affected by it (Site Safe, 1999). The issues that are found at this planning stage include: the mechanisms for the management of health and safety of the site in terms of identifying hazards, evacuation, and frequent site safety checks; the evaluation and monitoring systems for checking that the health and safety plan is being followed.

In order to realize the above, the following questions should be answered:

- How should health and safety responsibilities for implementation on site be assigned?
- How should the various methods for hazard be identified?
- How should incident and accident investigation and reporting methods be carried out?
- What are the strategies for site meetings and information sharing?

3 Research Methodology

The study reported adopted a quantitative research approach, wherein a questionnaire survey was used for data collection. Collis and Hussey (2003) describe a survey as a positivistic methodology that draws a sample from a larger population in order to draw conclusions about the population. The non-probability convenience sampling technique was used in identifying the study respondents. According to Collins, Onwuegbuzie, and Jiao (2007) this is a sampling method that involves choosing from a sample that is not only accessible but the respondents are willing to take part in the study. The study was such that the respondents were asked questions based on the projects they were found handling during the self-administration of the questionnaires. This may explain why the responses obtained were limited to 42 and invariably 42 construction projects were examined. Hence, the unit of analysis was the construction project handled by each respondent. A unit of analysis according to Collis and Hussey (2003)

refers to the phenomenon under study, about which data is collected and analysed. The data was analysed using descriptive statistics.

4 Findings and Discussion

The study sought to find out the level of experience of the respondents. Data collected in this regard is presented in Table 1.

Table 1. Years of experience of respondents

Years of experience	Respondents	Percentage
1-5years	21	50.0
6-10years	13	31.0
11-15years	5	11.9
16-20	3	7.1
Total	42	100.0

(Source: Field survey, 2015)

Table 1 indicates that 50.0% of the respondents have between 1-5 years of experience, 31.0% have between 6 - 10 years of experience, 11.9% of the respondents have between 11-15years of experience and 7.1% of the respondents have between 16- 20years of experience and above. Based on the result, 50% of the respondents had amongst them 6-20 years of experience in the construction industry; this is an indication that their responses can be deemed to be reliable as they should have the requisite knowledge of health and safety issues.

The study sought to know the factors considered during the pre-tender stage planning for health and safety. Table 2 shows the factors considered during pre-tender stage planning for health and safety on site, these were measured using a five point Likert scale with scores from 1= No Influence, 2=Little Influence, 3=Moderate High Influence 4= High Influence, 5= Very High influence.

Table 2. Factors considered during pre-tender stage planning for health and safety

S/N	Factors	NR	TS	MS	RANK	Decision
A	The positioning of the access or existing point	42	173	4.11	1 st	Hi
B	The type of the project	42	165	3.93	2 nd	HI
C	The location of the project	42	164	3.90	3 rd	HI
D	The local environment	42	164	3.90	3 rd	HI
E	The complexity of the project	42	161	3.88	4 th	HI
F	Specific client needs	42	157	3.74	5 th	HI
G	Existing planned design and information that cannot be avoided	42	149	3.55	6 th	HI

Key: NR=Number of responses; TS=Total score; MS=Mean score; RNK=Rank; HI=High influence
(Source: Field survey, 2015)

The result presented in Table 2 reveals that from a ranking perspective, that an existing planned design and information that cannot be avoided or changed has the least mean score of 3.55 and was ranked 6th followed by the specific client needs ranked fifth with (MS of 3.74). Some of the other factors that received the highest consideration are: The complexity of the project ranked fourth with (MS 3.88), the location of the project and the local environment which ranked third with (MS 3.90), the type of the project ranked second with (MS 3.93), and the positioning of the access or existing point ranked first with (MS 4.11). Based on Morenikeji (2006) cut-off points, it can be concluded that all the 7 factors have high influence and are considered during pre-tender stage planning for health and safety on those construction sites studied.

Table 3. H & S Practices used at the pre-construction planning stage

Health and safety planning practices	NR	TS	MS	RANK
Making arrangements to control the level at which visitor access construction site to minimize accident	42	161	3.83	1 st
Ensuring the competency of the subcontractors in providing suitable provision for safety	42	158	3.76	2 nd
Making arrangement to pass on information regarding safety issues from the client or designers/ adviser to other subcontractors and employees	42	156	3.71	3 rd
Obtaining and checking the site specific safety plans from subcontractors	42	153	3.64	4 th
Developing and carrying out site specific health and safety planning process	42	151	3.60	5 th
Ensuring that incident and accident are reported	42	151	3.60	5 th
Developing a designated safety budget as part of the normal operating budget.	42	150	3.57	6 th
Ensuring the arrangement for discussing health and safety matters with people on site	42	148	3.52	7 th
Ensuring the coordination and cooperation of subcontractors for information and on site for safety	42	143	3.40	8 th
Making sure that training for health and safety is carried out	42	143	3.40	8 th
Making arrangement to monitor health and safety performance	42	141	3.36	9 th

Key: NR=Number of responses; TS=Total score; MS=Mean score; RNK=Rank
(Source: Field survey, 2015)

The study found out that all documented H&S practices available to the researchers have a very high level of application on the construction projects examined with Mean Scores above 3.30. From a ranking perspective, making arrangements to pass on information regarding safety issues from the client or designers/ adviser to other contractors and employees was ranked 9th with (MS 3.36);, making sure that training for health and safety is carried out and ensuring the co-ordination and co-operation of subcontractors for information and on-site safety were ranked 8th with a mean score value of 3.40; ensuring the arrangement for discussing health and safety matters with people on site was ranked 7th with a mean score of 3.53.

In addition, making arrangements to control the level at which visitors' access construction sites to minimize accident; ensuring the competency of the subcontractors in providing suitable provision for safety; and making arrangements to pass on information regarding safety issues from the client or designers/adviser to other subcontractors and employees were ranked 1st, 2nd and 3rd respectively with mean score values of 3.83, 3.76 and 3.71. These findings are consistent with the results of earlier studies by - Okongwu (2010) who found that construction firms do not comply with health and safety provisions; Windapo and Jegede (2013) echoing the same thing stated that compliance level of indigenous construction firms in terms of health and safety policies and procedures was low; Alkilani *et al.* (2013) who established that there were inadequate training and education programmes; and Shibani *et al.* (2013) who report that workers are not trained and firms do not have safety officers which results in poor health and safety policies. In a related study, Jimoh *et al.* (2014) found that contractors' level of compliance regarding the provision of training and orientation on health and safety issues to workers in Ilorin-Nigeria was low.

Adapting one of the total quality management practices (commitment and leadership by top management at location) produced by the European Construction Institute as indicated in Harris and McCaffer (2005), it can be concluded that eight of the issues considered during the pre-construction planning stage for health and safety having mean score values greater than 2.50 are perceived by the respondents to support health and safety at the management level of all the construction firms studied. Conversely, the remaining three issues interrogated are perceived by the respondents to provide spasmodic support to health and safety during pre-construction planning due to their mean score values of 3.36 and 3.40 as shown in Table 3.

5 Conclusion and Further Research

The paper evaluates the health and safety planning process on construction sites in Kaduna Metropolis in Nigeria with a view to improving health and safety practices. Answers were sought to the factors that affect health and safety planning during pre-tender stage and the extent of health and safety planning put in place before the construction stage. The results showed that all the seven factors considered as the factors that affect health and safety planning during pre-tender stage, all had high influence on the planning process but the positioning of the access or exit point was ranked first with mean score of 4.11. In a related development, it can be concluded that eight of the issues considered during pre-construction planning stage for health and safety having mean score values greater than 2.50 are perceived by respondents to support health and safety at management level for all the construction firms studied. Conversely, the remaining three issues can be deemed to provide spasmodic support to health and safety during the pre-construction planning stage due to their mean score values of 3.36 and 3.40. Based on these findings, it can be concluded that accidents still happen on construction sites, despite the fact that construction companies consider all the factors affecting H&S at the planning stage and adopt appropriate H&S practices on projects during construction. Further research is therefore required that would match the frequency of accidents to factors considered during the project planning phase, and H&S practices applied during the project execution phase.

6 Acknowledgement

The authors will like to acknowledge the contributions made by all the respondents who provided site specific information used in preparing this paper.

7 References

- Adeogun, B.K. and Okafor C.C. (2013). Occupational Health, Safety and Environment (HSE) Trend in Nigeria. *International Journal of Environmental Science, Management and Engineering Research*, 2 (1), 24-29.
- Alhajeri, M. (2011). Health and safety in the construction industry: challenges and solutions in the UAE. Unpublished PhD Thesis. Coventry: Coventry University.
- Alkilani, S.Z., Jupp, J. and Sawhney, A. (2013). Issues of health and safety in developing countries: A case of Jordan. *Australasian Journal of Construction Economics and Building*, 13(3), 141-156.
- Bamisile, A. (2004). *Building Production Management*. Lagos: Foresight Press Ltd.
- Bureau of Labour Statistics (n.d). Number of fatal work injuries, 1992-2005.
- Bureau of Labour Statistics (2006). Workplace injuries and illnesses in 2005.
- Burke, R. (2010). *Project Management Techniques*. South Africa: Burke Publishing.
- Carter, G. & Smith, S. (2001). Construction safety risk: Improving the level of hazard identification. *Proceeding of European Safety and Reliability International Conference (ESREL 2001)*, Torino, Italy.
- Collis, J. and Hussey, R. (2003). *Business research: A practical guide for undergraduate and postgraduate students*, 2nd edition. New York: Palgrave Macmillan.
- Collins, K.M.T., Onwuegbuzie, A.J. and Jiao, Q.G. (2007). A mixed methods investigation of mixed methods sampling designs in social and health science research. *Journal of Mixed Methods Research*, 1 (3), 267-294.
- Cooke, B. and William, P. (2009). *Construction Planning, Programming and Control*, 3rd Edition. Oxford: Wiley-Blackwell.
- Edmonds, D. J. and Nicholas, J. (2002). The state of health and safety in the UK construction industry with a focus on plant operators. *Structural Survey*, 20(2), 78-87.
- Fang, D.P., Xiea, F., Huang, X.Y. & Lic, H. (2004). Factor Analysis-Based Studies on Construction Workplace Safety Management in China. *International Journal of Project Management* 22, 43-49.
- Harris, F. and McCaffer, R. (2005). *Modern Construction Management*, 5th Edition. Massachusetts: Blackwell Publishing.

Hassaneinin, A.G., and Hanna, R.S. (2007). Safety programs in Large-Size Construction Firms in Egypt. *Journal of Safety, Health and Ergonomics Research*, 4(1) 1-33.

Health and Safety Executive, (HSE).(2009).The Construction Intelligence Report. Available to download from: <http://www.hse.gov.uk/construction/pdf/conintrep0405.pdf>

International Labour Organisation (ILO, 1999). *Safety, health and welfare on construction sites: A training manual*. Geneva: ILO.

Jimoh, R.A., Ijjah, A.E. & Nuah, M. (2014). “Health and safety management practices level of compliance on construction sites in Ilorin Metropolis, Nigeria”. *Proceedings of the International Conference on Infrastructure Development and Investment Strategies for Africa*, Livingstone, Zambia, 25th – 26th September pp. 229-241.

Kheni, N.A., Gibb, A.G.F. & Dainty, A.D.F. (2006). The management of construction site health and safety by small and medium-sized construction businesses in developing countries: a Ghana case study. In: Boyd, D (Ed.) *Proceedings of the 22nd Annual ARCOM Conference*, 4-6 September 2006, Birmingham, UK, Association of Researchers in Construction Management.

Laufer, A., Shapira, A., Cohenca-Zail, D. and Howell, G.A. (1993). Prebid and preconstruction planning process. *Journal of Construction Engineering & Management*, 119(3), 426-444.

Malta Occupational Health and Safety Authority (2006). *Code of Practice for the Construction Industry part 1*. Malta: Malta Occupational Health and Safety Authority.

Morenikeji, W. (2006). *Research and Analytical Methods (for Social Scientists, Planners and Environmentalists)*. Jos: Jos University Press Limited.

National Occupational Safety & Health Information Centre (2006) Report of the National Occupational Safety & Health Information Centre, Geneva, Switzerland.

Okongwu, S.E. (2010). Effective safety and health planning on construction sites in Onitsha and Awka of Anambra State. Unpublished MSc thesis submitted to the Department of Building, Nnamdi Azikiwe University, Awka.

Onyejeji N., (2011), Nigeria Public Policy. Global Policy Brief, No 18, January 2011.

Saurin T.A, Formoso, C.T and Guimaraes, L.B.M. (2003). Safety and production: an integrated planning and control model. *Construction Management and Economics*, 21, 1-11.

Shibani, A., Saidani, M. and Alhajeri, M. (2013). Health and safety influence on the construction project performance in United Arab Emirate. *Journal of Civil Engineering and Construction Technology*, 4(2), 32-44.

Site Safe (1999). *Construction Safety Management Guide: Best Practice Guidelines in the Management of Health and Safety in Construction*. Wellington: Site Safe.

Windapo, A.O. and Jegede, O.P. (2013). A study of health, safety and environment (HSE) practices of Nigerian construction companies. *The Professional Builder*, 4(1), 92-103.

IMPACT OF ACQUISITION ON EMPLOYEE AND MANAGEMENT OPERATION – THE CASE OF EPCM ORGANISATION IN RSA

Kelani, Yakubu; Rwelamila, Panteleo D.

Graduate School of Business Leadership, University of South Africa, Midrand, Gauteng, South Africa

Abstract

Merger and acquisition (M&A), an emerging trend within organization practice as preferred vehicle for expansion and enhancing company performance. Past research conducted shows that cultural fit and change management plays a significant role in M&A success. It further posited that high failure rate of Merger and acquisition results from companies failing to critically examine the ramifications of cultural fit and appropriate change process. This paper examines the impact of the acquisition of Engineering Procurement Contract Management South Africa (EPCM SA) by an international entity on the employees and management operations. The research objectives are to conduct a literature review to explore the existing knowledge about the impact of acquisitions on employees and management and an empirical study on the impact of EPCM SA's acquisition on its employees and management. This paper draws on primary data from a sample of 300 employees of the newly formed entity through the use of self-administered questionnaire and data statistical in nature. Findings revealed that, acquisition negatively impacts employee's job satisfaction, operation performance, resulting in large employee turnover. Further research is suggested in the areas of cultural bridging and whether the nature of an organisational culture influences the type of change model and the change process that are adopted for acquisitions.

Keywords: Acquisition, Cultural fit, Change process, Employee satisfaction, Merger

1 Introduction

In general, organisation seek merger and acquisition as the preferred vehicle for growth strategy and market competitiveness. According to UK Construction news (2000), the Egan Report (1998) is commended for driving M&A activity in the construction sector in the past two decades despite the effects of the global recession. Trend towards consolidation in construction businesses is growing stronger with notable high-profile UK acquisitions including Scott Wilson by URS, Eaga by Carillion, and Davis Langdon by AECOM.

According to Cartwright (2006:1-5), organisation in seek to increase their market share either through organic growth or by means of merger and merger and acquisition (M&A).In South Africa(SA),M&As emerged after the Post-post-apartheid era. This includes trends like hosting of the 2010 Soccer in South Africa. Construction activities i.e., modern stadia, roads and hotels that were constructed in preparation for the FIFA World Cup, resulted in numerous mergers in the construction sector. Prominently in the construction sector was strategic decision of Group Five South Africa to acquire Quarry Cats, a construction material business sector (Group5 annual review 2009:4). The intent of the acquisition was twofold: firstly, to increase the

multiple margin stream baskets and secondly, to enhance the group performance (Group5, 2009). Bandrick and Karpaty (2010:211-224) state that researchers have mixed reactions to the effects of acquisitions. On the one hand, authors such as Conyon et al. (2000) argue that acquisitions lead to job losses and a cultural misfit within the acquired firms because the international entity tend to be less committed to the host economy's labour requirements. On the other hand, an alternative school of thought, as posited by Carrillo (2011), maintains that acquisitions strengthen the competitiveness of the acquired firm because it benefits from technology transfer, which in turn improves the management, operations performance, growth and profitability of the firm. Clearly, this contradiction needs further examination. Against the background of this contradiction, in the literature, it is important that managers and policymakers understand the effects of M&As on employees and business.

EPCM SA is of the concern that the acquisition by the international entity lacks full alignment of a proper acquisition procedure and strategic plan, which resulted in lack of commitment and productivity. For this reason, this study analyzed the impact of an international entity acquisition of Engineering Procurement Contract Management South Africa (EPCM SA). The main objective of the study is to assess the impacts of the acquisition of EPCM SA by an International entity on employees and management operations. However the study identifies the following specific objectives which are: investigate the importance of cultural due diligence between the acquiring company and the target company; investigate if the transition was understood and owned by all the employees and evaluate the relationship between changes in the organisational structure and the management leadership style of EPCM SA.

The study however intends to answer the following specific research question:

- (i) Is there any cultural relationship between EPCM SA and the International entity?
- (ii) How was change communicated and managed during the acquisition process?

The authors adopt a triangulation research method approach for the study using a predefined group of 300 participants considered more appropriate for the study and a sample from various disciplines in the new entity. A self-administered questionnaire is adopted and data obtained is analysed using a descriptive and inferential statistics. The results of this study clearly reveals that M&A impacts negatively on cultural fit and change process, and if not critically examined by the parties concerned, it may impact on the success of the M&A. It is imperative that Leaders of organisation embarking on M & A within the construction sector need to take cognisance of cultural fit and change process required between two entities before embarking on M&A.

2 Theory and Practice of Mergers and Acquisition

In general, organisations worldwide seek to increase their market dominance and competitiveness through Merger and Acquisition, a growing strategy for organizations. It is critical and timely to identify key planning steps that will assist organisation leaders and companies' boards to achieve M&A success. There are four types of acquisitions, namely: horizontal, vertical; conglomerates and congeneric acquisition (Green and Cromley, 1982:359).

Different acquisition is used to achieve different objectives or strategies.

2.1 Types of acquisition

2.1.1 Horizontal acquisitions

This takes place to expand control over business activities in the same industry segment and leading to a simultaneous increase in market share and the elimination of competition. Horizontal acquisition gives higher edge over competition (Green and Cromley, 1982:539; Weston, Chung and Siu, 1990:5).

2.1.2 Vertical acquisition

This occurs when a company acquires another company that is in different stages of its production operations (Weston et al., 1990:5). It can be further classified as backward and forward acquisition (Brealey et al., 2008:883).

2.1.3 Congeneric acquisition

This can be defined as acquiring a company that is in the same industry, but is neither in the same line of business nor a supplier or customer (Giltman, 2009:767). This occurs between two companies in unrelated lines of business (Brealey *et al.*, 2008:883; Giltman, 2009:767).

2.1.4 Conglomerate acquisition

This is expansion by acquiring companies into new and different product lines (Green and Cromley, 1982:359). One of the objectives of a conglomerate acquisition is to reduce business risk by acquiring companies through diversification of its interest.

The authors view that the horizontal acquisition definition best describes the acquisition between EPCM SA and the international entity acquisition process. Hill et al (2003) document the following as reasons why organisations take part in Conglomerate acquisitions as: Increase market dominance, Overcome entry barriers, Increase diversification, Merger for risk spreading and defensive drivers.

2.2 Challenges Facing M&As

Hill et al. (2003) mention some of the inherent challenges of the acquisition process include: lengthy acquisition processes; integration difficulties; and inadequate evaluation of targets. Gilkey (1991) argues that the high failure rate of M&As is mainly because they are still designed with business and financial fit as the primary condition, leaving psychological and cultural issues as secondary concerns. Some studies have focused on identifying the specific reasons for the failure of mergers or acquisition, for example Gadiesh and Ormiston (2002) list five cause of acquisition failure as: Poor strategic rationale; Mismatch of cultures; Difficulties in communicating and leading the organization; Poor integration planning and execution; and Paying too much for the target company.

Giving the importance of aligning strategic planning policy to M&A strategy, it is crucial to ensure a diligent process between organisation strategic plan and M&A plan. Sinickas (2004) defines due diligence as where each party tries to learn all it can about the other party to eliminate misunderstanding and ensure the price is appropriate. The author's view is that effective due diligence should be a comprehensive analysis of the target company's entire business, not just an analysis of their cash flow and financial stability has traditionally been the case.

2.3 Impact of acquisitions

Bajaji (2009) argued that, the role of the Human Resources Department (HR) teams in acquisition integration is encapsulated in two sub-processes: The first sub-process enables the integration of people through culture-building exercises, communication and facilitation of learning. The second sub-process enables the integration of the human resource practices and processes through a combination of structures, reward systems, service conditions and policies on employee relations.

2.3.1 Employees

Froses et al. (2008) found that employee satisfaction during an acquisition depends on the strategy that is used during the integration process and whether the integration meets their standards or expectations solely depends on the level of their resistance to the change.

According to a survey conducted by Chambers and Honeycutt (2009 :17), an acquisition causes low morale among employees, which in turn leads to reduced levels of commitment. This further confirms Conyon et al. (2000) views on acquisition.

2.3.2 Management

Angwin and Meadows (2009) found that acquisitions have long-term effects and significant impact on executives who were hired after the acquisition, and a significant portion of the incumbent executives who departed after the acquisition left involuntarily. Krug and Aguilera (2005:121-151) attest that in the long run, acquisitions create long periods of instability in the target company's top management team.

2.4 Organizational culture and acquisitions

Culture is defined differently in various disciplines Robbins and Stylianou (2003) as: "A set of values that influence societal perceptions, attitudes, preference and responses." Mercer (2006:1365) indicates that cultural integration is aimed at shaping a new culture through mutual absorption and strengthening of the various cultural strains via effective communication. According to Froses et al (2008: 97-108), it has been observed that cultural integration is closely related to personnel issues and employee change is crucial in an organisational culture. The post-acquisition culture must be determined in the beginning, and then the integration process can be implemented by using the best path to reach the desired goal (Dunaway, 2008). Cultural integration is not merely merging different cultures into one; it is a process of establishing the new organisation model by absorbing, selecting and integrating the cultures of two different organisations that are becoming one organisation. Culture mapping is also used to understand the similarities and gaps between national and corporate styles. A fundamental element of cross-culture management, as further argued by Abel (2007:1-5), is respecting and understanding another culture, attaching importance to communication and adapting to new tools. A survey conducted among senior executives worldwide who were involved in acquisitions revealed that 47% considered achieving cultural alignment a critical people issue, while 62% thought that ensuring effective communication was the most valuable human factor for acquisition success.

2.4.1 Organization change management

According to Peterson and Voules (2007), different paces and patterns of change and change management give rise to different kinds of internal and external difficulties and resistance to change during an acquisition process. Changes create the impression that employees and management will lose their jobs, as a result of a new strategic direction that the organisation takes. Kotter (2007) state that if change management is poorly handled, change impact employee and management productivity and erode employee and management engagement. The literature documents several models of change management, three of which can be summarised as follows: Kotter's eight-step model (1995) change process allows an organisation to develop a consistent planning and implementation framework that sets out clear objectives for the relevant stakeholders; Adakal's model (1999) an outcome-oriented approach to facilitate individual change to help leaders realise their objectives quickly and completely; Lewin's three-step model (1943). Prior to a change process, the change agent should understand why change must take place.

3 Research Methodology

The combination of a quantitative and qualitative approach was adopted in this study. Leady and Ormrod (2010) argue that the mixed method design with both qualitative and quantitative elements often provides a more complete particular phenomenon than either approach could

have done alone. This methodological design is particularly useful in expanding our understanding and knowledge of merger and acquisitions in term of its impact on human behaviour and the issues surrounding cultural integration. This exploratory study uses both the qualitative and the quantitative method implying that the research provides a more complete picture of a particular phenomenon, often referred to Mixed-method (Leedy and Ormrod 2002:97).The self-administered questionnaire interviews a target sample of three hundred participants consisting of three distinct groups within the entity: employees, human resources and management of both entities. The various strata considered for sampling was determined by taking into account all the departments that constituted the core business of EPCM SA. Table 1 below shows the proportions and numbers of respondents from all the major business units.

The major topic covered in all the interviews is (i) How is change communicated and managed during the acquisition (ii) examine if the transition was understood and owned by all the employees (iii) Is there any cultural relationship between EPCM SA and the International entity? (iv) Identify if the M&A experience was satisfactory (v) Is there a cultural relationship between EPCM SA and the international entity.

Table 1. Sample selection of participant Interviewed

Business unit	Total population	Sample size
Engineering	200	50
Project management	40	26
Procurement and Contracts	35	24
Operations	925	191
Total	1200	291

4 Findings and Discussion

The research present the synthesis and analysis of the findings of the study, building on the statistical analysis and data obtained from the acquisition themes as used in the questionnaire. Table 2 below is centred on level of satisfaction and further discuss the impacted on employees and management operation post acquisition between EPCM SA and the international entity.

Table 2. Acquisition themes used in questionnaire and level of satisfaction

Acquisition factors affecting employee and management operations	Level of satisfaction	Mean satisfaction level
Organisational Culture	Low satisfaction	22%
Communication	Low satisfaction	48%
Departmental integration	Dissatisfied	39%

* Low satisfaction 0% -50%

4.1 Organisational culture

The cultural fit after the acquisition was unsatisfactory for 78% of the respondents, while 22% was moderately satisfied with it. The new company's policies and procedures were unsatisfactory to 42% of the respondents and the majority (56%) of the respondents were moderately satisfied .on the overall, the data collected showed the cultural assessment was not effective and the cultural integration plans put in place were misaligned. It is evident from the above that there was no cultural relationship between the two organisations.

4.2 Communication

The major weakness in the acquisition process was lack of adequate communication, which was evident in the comments of the majority of the respondents who indicated that they had learned of the acquisition through informal meetings and discussions. 51% of the respondents were unsatisfied, 48% was moderately satisfied and only 3% found the communication model very satisfactory. There were no trust, transparency and engagement on the part of management and HR.

4.3 Departmental integration

EPCM SA's employees' levels of satisfaction and morale were low as a result of that the instability of the business created by the acquisition. The integration of co-workers was unsatisfactory for 59% of the respondents and 39% was moderately satisfied. The levels of job security were low for 57% of respondents, while 2% was very satisfied with their levels of job security after the acquisition and little clarity on employee roles and responsibilities has resulted in the inability of employees to adapt to the new culture and systems of the new entity.

4.4 Change management and time frame

Change could either be planned or emergent, the psychological challenges that was noticeable among co-workers because of the acquisition include the threat of job loss was highest (93%), followed by a sense of insecurity (89%) and job changes (71%). A sense of uncertainty was noticed by 39% of the HR respondents and social welfare concerns were noticed least (7%). Evidently, the assimilation time frame was not enough to give EPCM SA ample time to understand the new entity systems before they were implemented. The project delivery assimilation time was overrun due to the little or no time allowed for employees to adopt the new project integrated system, this indicates that Adakal's model (1999) was adopted and explains why the rapid integration and assimilation process was misaligned as shown in table 3 below. Before the acquisition, investment was between 31% and 45% (as mentioned by 39% of the managers); and foundation building investment was between 46% and 60%, rapid integration and assimilation investment between 31% and 45% according to 39% and 55% of managers respectively.

Table 3. Time resources invested in the transition process

Modal classes	Pre-acquisition	Foundation building	Rapid integration	Assimilation
31%–45%	45%		39%	
46%–60%		52%		55%

Furthermore, given that the acquisition is still on-going after two years, the level of uncertainty regarding the roles of management and employees of EPCM SA within the new entity further support Conyon et al. (2000)'s view on acquisition.

5 Conclusion and Further Research

The main purpose of this study was to determine and evaluate the impact an international entity acquisition of EPCM SA had on employees and management operations. The research paper conducts a literature review to explore the existing knowledge about the impact of acquisitions on employees and management and an empirical study on the impact of EPCM SA's acquisition on its employees and management operations, analysing the research result and their outcomes built on the data obtained through the survey questionnaire.

M&As have a very long history; and has been in existence at least since the 1900s. The introduction of globalisation has strengthened corporate companies emphasis on the need to create a multi-national organisation. However, many organisations are under the impression that implementing the M&A process is quick and easy and they often underestimate the level

of due diligence, power of cultural fitness and change management required to integrate organisations in a way that impacts positively on employees and management operations. It is important that organisations assess culture fitness, systems integration and the prevalent communication model and planned change management. The following findings and conclusion can be drawn from this study:

5.1 Existing organisational culture post acquisition

The study found that, the current culture of the organisation is a “misfit culture”. This means that the integration of the two cultures into the new organisation has not yielded employee and management satisfaction. The management of the new organisation has failed to focus more on bringing about cultural integration through an effective change process in the new organisation by focusing on and planning market penetration and diverting risk. It is recommended that the management of EPCM SA revisit the three key themes of cultural bridging fundamentals (legitimacy, effectiveness and the future) as it is in these three areas that leaders must develop an understanding, not only of the approach favoured in their own corporate culture but also of that of their future partners.

5.2 Existing employee satisfaction

The study found that, the overall employee level of satisfaction within the organisation is very low. This was the dominant view obtained from the research findings and based on the continuous drift of the acquisition process across the organisation over the last two years. The study recommends that, in changing employees’ perceptions for stability and commitment within the new entity, HR implements an awareness programme for employees on the opportunities that are available within the new entity and what makes the new entity a great organisation to work with.

5.3 Relationship between organisational culture and employee and management productivity

The results revealed that there is no relationship between culture and productivity among the employees and management in the new organisation. The research results show that the management’s leadership style was weak and contributed to the poor cultural integration. It can be assumed that similar organisations that undertook an acquisition in the South African construction sector will have the same result for cultural integration, indicating no relationship between the organisational culture and employee and management productivity

5.4 Effect of organisational culture on employee productivity

Organisational culture was found to influence and impact employee productivity. In the study, management witnessed reduced levels of productivity and instances of sabotage. This means that the organisation’s culture influences the productivity rate of employees and plays a role in whether the organisation can execute its projects timeously and within the stated budget. It can be assumed that a similar organisation in the South Africa engineering consulting sector will have the same result – that organisational culture influences employees’ productivity.

5.5 Effect of communication on employee and management operations

The study found that, the organisation’s communication model influences and impacts employee and management operations. The communication model in the new organisation reflects a bureaucratic leadership style. Communication flow is under strict control and this causes employees and management operations to be easily questioned. An open democratic communication model is the most suitable model for an organisation that strives to be the leading engineering and consulting company in South Africa.

6 Recommendations for future research

1. Future studies can examine how government regulations and policy influence the success and failure of M&A's and strategic alliances between multinational organisations and organisations in South Africa.
2. Future research can focus on the impact that cultural fit will have on a strategic alliance/partnership, instead of an M&A, in similar industries in South Africa.
3. Future studies can focus on determining if the nature of an organisational culture influences the type of change model and change process that should be adopted for M&A.

7 Acknowledgement

The Author's acknowledge Professor P. D. Rwelamila for his guidance, continuous academic support and industry knowledge in the area of research.

8 References

- Amaratunga, D, Baldry, D, Sarshar, M and Newton, R (2002). Quantitative and qualitative research in the built environment: Application of "mixed" research. *Work Study*, 51(1):17–31.
- Abel, MR (2007). *The importance of leadership and culture to Merger and Acquisition success*. Human capital institute, pp1-5
- Angwin, D and Meadows, M (2009). The choice of insider or outside top executive in acquired companies. *Long Range Planning*, 42 (3) pp.35-389.
- Bajaji, H 2009. *The process of HR intergration in mergers and acquisition*. Unpublished MPhil dissertation, Tata Institute of Social Sciences, Mumbai.
- Brealey, R.A., Meyers, S.C. and Allen, F (2008). *Principles of corporate finance*. New York: Mcgraw Hill.
- Cartwright, S. and Schoenberg, R (2006). 30 years of merger and acquisition research: recent advance and future opportunity. *Journal of Management*, 17(1) pp. 1–5.
- Conyon, M, Girma, S and Thompson, S (2000). *The impact of merger and acquisitions on company employment in the UK*. Nottingham: Centre for Research, School of Economics, University of Nottingham.
- Daniel, TA and Metcalf, GS (2001). *The management of people in mergers and acquisition*. Westport, CT: Quorum.
- Froses, FJ, Pak, YS and Chong, LC (2008). Managing the human side of cross-border acquisition in South Korean. *Journal of World Business*, 43 pp.97–108.
- Green, MB and Cromley, RG (1982). The horizontal merger: Its motives and spatial employment impacts. *Economic Geography*, 58(4):358–370.
- Gilkey, R (1991). *The psychodynamics of upheaval: Intervening in merger and acquisition transactions*. San Francisco, CA: Jossey-Bass.
- Gitman, LJ (2009). *The principle of managerial finance*. Boston: Pearson prentice hall.
- Kotter, JP (2007). Leading change, Why transformation efforts fail. *Harvard Business Review*, pp 92.107
- Leedy, PD and Ormrod, JE (2010). *Practical research: planning and design*. Upper Saddle River, NJ: Pearson Education.
- Kotter, JP (2007). Leading change, 'Why transformation efforts fail' *Harvard Business Review*, 85 (1) pp. 96-103.
- Pearson, B (1999). *Successful acquisition of unquoted companies: A practical guide*. Brookfield, VT: Gower.
- Pearson, L and Voules, S (2007). *Reflection on M & A: The human capital*

dimension.NewYork: Mercer Human Resources Consulting.
UK Construction news (2000): M&A boom: [Http://www.ft.com/cmcs/o/a8a71814-560b-11dabo0000e25118html#axzz3QZejjNpF](http://www.ft.com/cmcs/o/a8a71814-560b-11dabo0000e25118html#axzz3QZejjNpF).(Access 23rd September 2015)

PUBLIC PRIVATE PARTNERSHIPS FOR ROADS MAINTENANCE AS A VEHICLE FOR SKILLS TRANSFER AND ENTREPREISE DEVELOPMENT IN SOUTH AFRICAN RURAL COMMUNITIES

Matshidze, Lindelani

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of the Witwatersrand, Johannesburg, Gauteng, South Africa

Oyegoke, Adekunle Sabitu; Ogunlana, Stephen

School of Built Environment, Faculty of Engineering and Built Environment, Heriot-Watt University, Edinburgh, United Kingdom

Abstract

This paper outlines the justification for a doctoral study on PPPs for road maintenance as a vehicle for skills transfer and enterprise development. South Africa’s rural communities’ struggles with three main problems, lack of skills, low private sector investment and poor infrastructure, which undermines investments in rural communities. Even those with basic skills, the lack of opportunities undermine their ability to deepen their skills and improve their earning potential. The aim of the study is to develop small scale PPP framework that is appropriate for rural road maintenance in rural communities that have as part of their core purpose, a specific emphasis in fostering enterprise development and skills transfers to develop sustainable businesses within those communities. The paper looks at the current level of infrastructure and skill deficits in SA rural communities and the role that well maintained roads can have on improving the delivery of public goods and service, as well as improving access to economic activities. The review concludes with an evaluation of the extent to which road maintenance can contribute to skills transfer and enterprise development and whether the current PPPs models and policy can be modified to foster economic development and skills transfers in SA rural communities.

Keywords: Enterprise development, PPPs, Roads, Rural skills transfer

1 Introduction

This study is on PPPs for road maintenance as a vehicle for skills transfer and enterprise development. South African faces a high unemployment rate of 25% (Stats SA, 2014). One of the causes cited for this high unemployment rate has been the lack of skills and less formal entrepreneurships (Ibid), as the high levels of unemployment co-exist with reports of skilled vacancies by employers (Ibid) and low levels of entrepreneurship compared to other middle-income countries (Styles et al, 2006). This picture however is particularly concentrated in rural communities, in part a historical legacy of apartheid policies of using rural communities as reservoirs of cheap labour (Gibbs, 2014). The apartheid government’s explicit policy was to undermine the rural economies to force men from those communities to migrate and work in the mines and cities (Binns and Nel, 1999). Woman and children were mostly left in the villages surviving on remittances from male migrant labour, preventing the establishment of any sustainable economic activity in the rural areas (Ibid).

The incidence of unemployment is across education, age and race. About 58% of those formally employed have at least matriculation level education (12 years of schooling), compared with only 38% of the total working-age population (McGrath and Okooje, 2007). Since 1994, the African National Congress (ANC) government has launched a number of interventions to address the skills gap, develop rural communities and foster SMMEs (Small Micro and Medium Enterprises). More recent initiatives targeted at the rural areas to offer skills and employment include the National Rural Youth Service Corps (NARYSEC) through the Department of Rural Development and Land Reform (DRDLR), National Youth Service (NYS) and the Extended Public Works Programme (EPWP) operated through the National Department of Public Works (NDPW).

2 Literature Review

2.1 State of infrastructure

Infrastructure is defined as the services drawn from the set of public works that traditionally have been supported by the public sector, although in many cases the infrastructure services may be produced in the private sector (Fox and Porca, 2001). Water, sewerage, solid waste management, transportation, electricity, and telecommunications are examples (Ibid).

South Africa boasts a much-advanced infrastructure in its urban centres, however the picture is a different one in the rural areas (Bogetik and Fedderke, 2005). South Africa's critical infrastructure needs are in part the outcome of two decades of underinvestment (Ibid). South Africa experienced under investment public infrastructure spending between the early 1980s and until mid-1990s (Ibid). After this point, government began to increase capital spending, with a sharp rise after 2003 as prudent management of the economy created the fiscal space for long-term investment (National Treasury, 2012). Private-sector capital formation has also increased strongly, rising by 84 per cent between 2002 and 2008 (Ibid).

According to the SA Treasury, South Africa needs to invest at least 25 percent of its Gross Domestic Product (GDP), to address its infrastructure deficit (Treasury, 2012). The experience of other developing countries shows that capital investment equivalent to about 25 per cent of GDP is generally needed for a substantial rise in per capita income (DoT, 2012). In recent years, government has sought to accelerate public infrastructure spending, while also encouraging greater private-sector investment (Ibid). South Africa's public-sector capital investment stood at 7.4 per cent of GDP in 2010, while investment by private enterprises amounted to 12.2 per cent of GDP (Treasury, 2012).

South Africa experienced a massive rise in infrastructure spending in the run up to the hosting of the 2010 FIFA World Cup (DoT, 2012), however since the soccer tournament the expenditure has fallen off (Ibid). The decrease in public investment in public infrastructure is because of the country trying to address other social needs such as welfare, healthcare and education (National Treasury, 2012). Because of South Africa's rising debts, other funding models such as PPPs are required to finance the country's infrastructure deficit.

The experience of other developing countries shows that capital investment equivalent to about 25 per cent of GDP is generally needed for a substantial rise in per capita income. In recent years, government has sought to accelerate public infrastructure spending, while also encouraging greater private-sector investment (National Treasury, 2012). South Africa's public-sector capital investment stood at 7.4 per cent of GDP in 2010, while investment by private enterprises amounted to 12.2 per cent of GDP (Ibid). Government and state enterprises are expected to allocate funding of R262 billion over the next three years to transport and logistics infrastructure (Ibid). These investments will improve public transport and the mobility

of people and services, overcome spatial inequalities, boost the economic potential of certain regions, and increase domestic and international trade capacity (DoT, 2012).

2.2 State of road infrastructure

The challenge with regards to transport infrastructure is not only limited to the physical deficit but also lack of linkages between roads and rail lines, and poor connectivity to ports (ADP, 2010). This has resulted in Africa being the world's worst rated region in the Logistics Performance Index (LPI) in 2009, even though the picture varies considerably across countries (Ibid). While African governments and development partners are investing more in roads and rails infrastructure much more needs to be done for any meaningful socioeconomic impact to be made (Ibid).

According to South African National Roads Agency (Sanral), South Africa's total road network is about 747,000km the most extensive is Africa (Sanral, 2014). Roads in SA are controlled by the Department of Transport, however the department is primarily responsible for policy development. The actual building and maintenance of roads is split amongst the 3 spheres of government (national, provincial and municipal) and the responsibility of national (undertaken by Sanral) and the provincial and municipal road agencies.

According to the South African Institute of Civil Engineering (SAICE), Sanral is responsible for 16,200km, provincial agencies for 185,000km and the local municipalities responsible for 66 000km (SAICE, 2014). Around 19% of the national road networks are toll roads, most of which are maintained by Sanral, while the rest have been concessioned to private companies to develop, operate and maintain.

2.3 Skills and Enterprise development

One of South Africa greatest causes of its high levels of poverty is unemployment and low paid work (Ray et al., 2014). Government's position is clear: the new development and growth path for South Africa requires the participation of all economically active South Africans in productive activity. Our policy levers to achieve faster growth, higher employment and reduced levels of poverty include skills development which must assist support the formal private sector growth but also labour-intensive industries, infrastructure investment, public service delivery and rural development. Quality education and training is needed at all levels.

2.3.1 Skills Development

Skills Development means developing yourself and your skill sets to add value for the organization and for your own career development. Fostering an attitude of appreciation for lifelong learning is the key to workplace success. Continuously learning and developing one's skills requires identifying the skills needed for mobility at Cal, and then successfully seeking out trainings or on-the-job opportunities for developing those skills (Berkeley. Edu. n.d.).

The role of skills development is central – but anticipating what skills will be needed, and when, is no easy matter (Lassnig, 2006). Careful planning is needed to support the human development needs necessary to fuel our aspirational growth path (Ibid). Sector Skills Plans (SSPs) are expected to anticipate and promote sectoral economic growth trajectories and constitute our best guess at the skills needs of an essentially unknowable future.

Analysis of economic development and employment trends includes a consideration of national and sector growth and development strategies, particularly those related to the National Economic and Development Strategy, the National Human Resources Development Strategy and those related to the Industrial Policy Framework, innovation and technology and Rural Development. In accordance with the requirements of the Skills Development Act (1997) as amended (December 2008).

2.3.2 Enterprise Development

Enterprise development is defined as the act of investing time and capital in helping people establish, expand or improve businesses. Enterprise development helps people to earn a living; it helps them out of poverty; and it leads to long-term economic growth for themselves, their families and their communities (USB-ED, n.d.).

Since the advent of democracy in 1994, the national government of South Africa has implemented a range of new national support programs designed to assist entrepreneurship development and the upgrading of the Small, Medium and Micro-enterprises (SMMEs) (Mathibe, 2010). SMMEs are recognized as an important vehicle to address the challenges of job creation, economic growth and equity in South Africa (Ibid). Governments throughout the world are focusing on the development of the SMME sector to promote economic growth (Mago and Toro, 2013).

The definition of SMME used by the DTI in South Africa is any business with fewer than 200 employees and an annual turnover of less than 5 million rands, capital assets of less than 2 million rands and where the owner is directly involved in the management of the business (Cronje *et al.*, 2000). SMMEs in the South African context are classified into five categories:

- a. Survivalist enterprises;
- b. Micro enterprises;
- c. Very small enterprises;
- d. Small enterprises; and
- e. Medium enterprises.

The survivalist enterprise is generally seen as providing an income below the poverty line (Chalera, 2007). Micro-enterprises are considered as businesses with a turnover of below the VAT registration limit of R300, 000 (Ibid).

In post-apartheid South Africa, major policy significance is attached to the promotion and support of the small, medium and micro-enterprise (SMME) sector (Mathibe, 2010). A radical policy shift has occurred from the apartheid period when the SMME economy was either largely neglected by policy makers or, in the case of black-owned enterprises, actively discouraged by an arsenal of repressive measures (Rogerson, 1999). In the changed policy environment of the 1990s, promotion of the SMME economy is linked to a range of new policy objectives, including poverty alleviation and enhancement of national economic growth (Agupusi, 2007). The National Project on Poverty and Inequality highlights the importance of assisting the SMME economy as part of a package of integrated strategies for poverty alleviation in urban and, more especially, in rural areas (Ibid). Programs for nurturing the SMME economy are seen as offering a basis for addressing poverty and inherited apartheid inequalities through strengthening existing coping strategies of poor households or by offering alternative livelihoods to those individuals engaged in the survival informal economy (May 1998). By contrast, in South Africa's new macroeconomic strategy, the Growth Employment and Redistribution (GEAR) programme, the strengthening of the SMME economy is identified as one of the core elements for achieving a medium-term improved growth and employment performance as well as for enhancing the long-term competitive capacity of the economy (Republic of South Africa, 1996).

2.4 Impacts of roads in delivering public good and services in rural communities

The World Bank defines the rural population as referring to people living in rural areas as defined by national statistical offices. It is calculated as the difference between total population and urban population (World Bank, n.d.).

Rural African communities are largely characterised by high levels of unemployment and poverty, low skills levels and a heavy reliance on natural resources (Milborne, 2004). Increasing populations, together with the impacts of climate change, are putting pressure on natural resources and the issue of sustainable land use is becoming critically important (Thomas and Twyman, 2005).

Besides road maintenance being crucial in creating work, road also contribute in enhancing and facilitating market interdependencies and promoting economic development (Hill et al., 2012). Foreign Direct Investment (FDI) flows to developing economies reached a new high of US\$759 billion, accounting for 52% of global FDI inflows in 2013. At the regional level, flows to Latin America and the Caribbean, and Africa were up; developing Asia, with its flows at a level similar to 2012, remained the largest host region in the world (UNCAT, 2014).

It is argued that improving road and rail systems in Africa will boost the transportation of goods and raw materials; facilitate transactions and negotiations, boost tourism and positively impact ordinary lives in diverse ways such as ensuring that people get to the hospital quickly during emergencies. Countless other activities depend on reliable transportation (Teravaninthorn and Raballand, 2008). As a result, transport costs alone are higher in Africa than in developed countries, hampering Africa's competitiveness in both international and local markets (Ibid). Before addressing the focal challenges of documenting the economic, social development, and poverty reduction impacts of road projects specifically, it is useful to briefly outline the impacts of major infrastructure investments in general. Recent reviews have shown that the impacts of one type of infrastructure (e.g., roads) on economic development, poverty reduction (Fan and Chang-Kang, 2005). The changing structure and increasing sophistication of the economy have altered the pattern of transport demand, with rapid growth in the demand for road transport compared with other modes (Ibid). The link between road development and poverty reduction is supported by studies and the evaluation of several completed road projects financed by ADB4 and the World Bank (Ibid).

From consultation with the poor, several studies have found that adequate transport infrastructure is a prerequisite for reducing poverty, and involving the participation of local communities increase the likelihood of success of road projects (Setboonsarng, 2005). Benefits for poor rural areas include lower transport costs; lower cost of inputs, expanded agricultural support services; improved farming practices; greater access to employment opportunities in urban areas; and better access to health, education, and social services (Ibid).

Rural poverty is linked to the exposure of the households to economic vulnerability, through their chronic dependence on small-scale agriculture for income generation. A starting point in mitigating this vulnerability would be a comprehensive improvement in accessibility. This would substantially reduce transportation cost and thereby lessen the isolation of rural communities from basic welfare services. Economic growth is endogenous. This means that growth levels are driven by the public expenditures including infrastructure investments but at the same time, public expenditures are driven by economic growth. Studies showed that countries with more developed infrastructure see a disproportionately greater impact of infrastructure on foreign direct investment, domestic investment, and growth (Globerman and Shapiro, 2002).

Reduced sensitivity to transport costs and time when marketing their own produce (Thomas, et al., 2005). Poor people near the poverty line are mobile and express demand for transport services (Velaga et al., 2012). They share equally in the qualitative benefits of improved access to health, education, social and community services, increased safety and security, and access to information (Ibid).

Government policy, initially through the Rural Development Strategy (1995) and the Rural Development Framework (1997), initiated the process of prioritising the transformation of rural

areas from 'surplus labour reserves' into dynamic local economies that are able to provide sustainable self-employment opportunities and remunerative jobs (RDF, 1997).

The purpose of this branch is to create an enabling institutional environment for sustainable rural development and to provide for social and economic development in rural communities and sustainable livelihoods. Its functions are based on the social mobilisation of communities to ensure that rural communities take ownership of rural development projects and programmes (DLRD, 2012).

2.5 Current SA PPP policies and their focus skills transfer and enterprise development

Public-Private Partnership can be described as legal binding agreements, which the public sector enters with the private companies as a tool in providing the statutory public infrastructure and/or management of public infrastructure. The characteristics of the partnership is that it is a legal transaction, longer duration, infrastructure provided can be lease property; sale, renovated or new and the service provided is normally a function of the public sector (Grimsey and Lewis, 2004).

South African Treasury defines PPPs or public private partnerships as long-term contracts between the public and private sector. The main objective of PPPs internationally is to ensure the delivery of well-maintained, cost-effective public infrastructure or services, by leveraging private sector expertise and transferring risk to the private sector (National Treasury, 2007). In 1999, South Africa launched its PFMA regulation and public private partnerships (PPPs) are regulated under this regulation. This regulation based on transparent public procurement of goods and services with its private sector partners (Ibid). This framework encourages mutually beneficial relationships between private and public sectors when government enters commercial transactions for the public good (SA Treasury, 2007).

Public Private Partnership (PPP) principles in South Africa have grown over recent years as the merits of blending private sector resources and skills, with the public ones has become evident (Wattenhall, 2003). It has also become clear that the PPP architecture is complex and such projects require a detailed understanding of their design and implementation (Ibid). A number of PPP projects have been facilitated and these projects have been followed by many public debates over the efficiency and efficacy of such a finding and delivery mechanism (Findlers, 2005). Debates have focused on issues including the death of the public sector ethos (Ibid); PPP is driven by political motive to control public spending rather than delivering better public services (Ibid); PPP projects actually cost more than conventionally procured assets (Hogde, 2004); and many others. South Africa is the leading sub-Saharan African country with respect to PPPs and, like most developing countries yet despite this relatively few PPP projects have achieved financial close and was classified by Deloitte and Touché (2006) as being only at the first stage of the PPP maturity scale (Bond et al, 2012).

Countries worldwide daily confront the Africa's high infrastructure deficit (Yepes et al., 2009). Evidence of the sizeable and burgeoning disparity between actual infrastructure needs and the resources that governments have historically invested in attempting to meet those needs is universal: congested roads; antiquated bridges in need of repair; poorly maintained transit systems and recreational facilities; and hospitals, schools, and waste treatment facilities all in varying stages of deterioration and urgently in need of restoration (Eggers and Startup, 2007). The SA Government acknowledges that public-sector capacity to implement projects is presently inadequate, and is taking steps to strengthen planning and implementation capacity at all levels (National Treasury, 2012).

South Africa is among the leading nations in policy, systems and law on the PPPs (Farlam, 2005). Through previous PPPs experiences the public service delivery has benefited through this model and it enhances the efficient delivery of services at minimal costs. To show the

private sectors confidence on the PPPs, they have been an increase of pipeline for projects and increased appetite from the private sector (National Treasury, 2012). South Africa boasts a well-developed policy and regulatory framework, which act as a guide on how all sphere (national, provincial and municipal) government can enter in to a PPP.

3 Expected Contribution of the Study

The aim of the study is to develop a PPPs framework that will be used for roads maintenance in rural communities that have as part of their core purpose, a specific emphasis in fostering enterprise development and skills transfers. Rural communities in South Africa have been marginalised from skilled work opportunities and formal business activities. Because of lack construction activities in rural areas even those who acquires skills through extended public works initiatives, they lack opportunities to deepen their skills. Roads in rural areas happen to be managed by local authorities, and rural local authorities experience a challenge in recruiting and retaining skilled workers.

4 Conclusion and Way Forward

For this study, an analysis of current policies on PPPs, skills transfer and enterprise development will be evaluated. This will helps in understanding current PPPs framework, strength and challenges. And current policies on skills transfer and enterprise, his will help us in finding current trends, success and challenges. Evaluating current policies will provide crucial data and statics on government targets and actual in areas of skills transfer and enterprise development. Interviews will be done with senior public officials in the economic, transport and PPP unit within the South African government. This will help in finding the reaction on developing new PPPs framework and in locating the most suitable stakeholder's with SA government. And lastly case studies on skills transfers and enterprise development will be used, to evaluate the current road maintenance regime against skills and enterprise developments.

- Reducing the transaction costs, and the skills and knowledge required – transaction costs have been an issue increasing the scope of PPPs to include municipal infrastructure.
- Expanding scope of projects – PPPs in South Africa has mainly be on office accommodation national government departments and national highways which falls under SANRAL
- Potentially applicable to a wide range of infrastructure – possibilities for a potential to foster PPPs model that can be in wide ranging infrastructure maintenance projects.
- Applicable to other rural environments in Africa and the developing countries – develop a best practice for rural roads PPPs that will be applicable to other developing nations.

5 References

- Agupusi, P. (2007). Small Business Development and Poverty Alleviation in Alexandra, South Africa, Paper prepared for the second meeting of the Society for the Study of Economic Inequality (ECINEQ Society, Berlin; July 12–14 2007) School of Development Studies, University of East Anglia, Norwich, UK
- Deloitte & Touche (2006). Closing the infrastructure gap: the role of public–private partnerships. [Online] Available at http://www.deloitte.com/assets/dcom-shared%20assets/documents/dtt_ps_closing_gap_061307.Pdf. Accessed: 08 May 2015.
- Fan, S and Chan-Kang, C. (2005). Road Development, Economic Growth, and Poverty Reduction in China International Food Policy Research Institute
- Findlers, M. (2003). The politics of Public Private partnerships

- Framework for the National Skills Development Strategy, 2011/12-2015/16, First Draft for Construction , 29 April, 2010.
- Hodge, G. (2004). The risky business of Public Private Partnership, Australian Journal of Public Administration
- <http://data.worldbank.org/indicator/SP.RUR.TOTL>, accessed 08 May 2015
- <http://hrweb.berkeley.edu/learning/career-development/skill-development>
- <http://www.theafricareport.com/North-Africa/transport-infrastructure-before-development.html>
- <http://www.usb-ed.com/content/Pages/The-impact-of-enterprise-development-in-South-Africa.aspx#1BU3uHksZS4lz6f3.99>
- Kathryn, R., Sissons, P. Katy J. and Vegeris, S (2014). Employment, Pay and Poverty: Evidence and policy review for the Joseph Rowntree Foundation
- Lassnig, L. (2006). Approaches for the anticipation of skill needs in the “Transitional Labour Market” perspective – the Austrian experience
- Mathibe, M. (2010). An Evaluation of Business Support Services to SMEs in the Free State, A Dissertation submitted University of Free state.
- Rogerson, M. (1999). Small enterprise development in post-apartheid South Africa: Gearing up for growth and poverty alleviation,
- Yepes, T, Pierce, J, Forster, V. (2009), Making Sense of Africa's Infrastructure Endowment: A Benchmarking Approach, World Bank Policy Research Working Paper No. 4912 Vol. (issue no.), pp. 11-25.

EFFECTIVENESS OF ELECTRONIC TENDERING FOR CONSTRUCTION PROJECTS

Balogun, Ayodeji; Talukhaba, Alfred Atsango; Opaleye, Oladele
Department of Building Science, Faculty of Built Environment and Engineering, Tshwane University of Technology, Pretoria, Gauteng, South Africa

Abstract

Historically, the construction industry being fragmental in nature is dominated with a wide range of technologies and e-activities with e-tendering at the forefront. However, e-tendering is the issuing and receiving of tender documents via internet based platform which makes the procurement of a construction project easier and faster. Despite the benefits that could be derived from the use e-tendering, many construction practitioners are still reluctant to fully use electronic tendering. Therefore, this study is aimed at exploring the factors affecting the wide use of e-tendering, effectiveness of e-tendering infrastructures and awareness level of e-tendering within the South African construction industries. Owing to the nature of the research questions the quantitative approach was used for this study. The questionnaire survey method is the research instrument used. The questionnaire survey was conducted among construction stakeholders actively involved in the planning of construction projects. Using a survey research type of research design, data was sought from quantity surveyors, architects, engineers, project manager and other construction stakeholders in the industry using survey research method. The results of this survey shows that no quantifiable measurement of e-tendering success, once-off nature of construction projects, limited knowledge of legal and security policies governing e-tendering and misunderstanding within the fragmented supply chain management system rank highest among the factors affecting it wide use and e-tendering effectiveness.

Keywords: Construction, E-tendering, Industry, Infrastructure, Practitioners

1 Introduction

The construction industry being fragmental in nature is dominated with a wide range of technologies and e-activities with e-tendering at the forefront. However, e-tendering is the issue and receipt of tender documents through an internet based system which facilitates the procurement of a construction project. The present paper based means of tendering has been used significantly over a number of years within the construction industry, and this method is faced with challenges which affect construction projects in terms of cost and timely completion of a project. The need to minimise and eradicate these challenges gives rise to the adoption of e-tendering and adjudication processes. Which would result in improve productivity, greater quality of work during the planning stage of a project, higher profitability and delivery of a construction project.

The construction industry is classified as an information intensive sector and described as one of the crucial industries in developed and developing countries facing a rapid and uneven change in the economy (Kajewski and Weippert, 2004:2). Tendering as related to construction

is the process by which tenders are invited from interested or competent contractors to undertake certain or specific packages of construction work.

Planning for construction projects involving large sum of money is a challenging and complex chore faced by both internal and external stakeholders involved in a project. According to Mohemad *et al.* (2010), a construction project life cycle consists of three phases, namely as pre-construction, construction and post construction. The pre-construction phase involves the planning and tendering process (Mohemad *et al.*, 2010:35). The tendering stage in construction industry is considered a crucial and important stage throughout the project lifecycle (Vee and Skitmore, 2003, p.118). This stage forms the contractual and legislative agreements between client, design engineer, contractor and other stakeholders of the project (Choen and Alshawi, 2009:101).

Tendering in construction was portrayed simply by Connell (2010) as a process that connects the client to the construction firm. Tendering is carried out most importantly to adjudicate competent contractor to undertake specific construction and design activity at the best reasonable cost, realistic time and acceptable quality.

Decision making during tendering has great impact in the successful execution of a construction project (Mohemad *et al.*, 2010, p.35). Mohemad *et al.* (2010) proceeded to say that managing tender is very cumbersome and uncertain. It involves the coordination of several activities and tender participants with different priorities and objectives. Bias and inconsistent decision are unavoidable during tendering if decision making system is dependent on intuition, subjective judgement or emotion (Mohemad *et al.*, 2010:35). This unavoidable decision is one of the major reasons why e-tendering should be encouraged and widely used by construction practitioners.

1.1 Problem statement

In spite of the fact that previous researchers generally conclude that e-tendering system is effective, the question is why tendering process is still based on manual activities i.e. traditional tendering system. Despite the benefits of e-tendering and the contribution to the procurement phase of a project, there are factors and challenges that affect the wide use of e-tendering. One of the factors that hinder the used of e-tendering is the isolated nature of processes without extensive integration prior or after tendering (Chilipunde, 2013). However, majority of the construction and consultancy firms are still sceptical of the potential benefits mainly due to limited human resources as regards the operation of the e-tendering process. These includes, financial resources, accessibility of internet, computer literacy amongst tendering participants, e-tendering software not user friendly, ineffective e-tendering infrastructure, legal and security issues, lack of government policy and the people. These are the main factors that hinder the use of e-tendering in the developed countries (Mohemad *et al.*, 2010:35). Research has shown that no extensive study has been conducted on this ineffectiveness and wide use of e-tendering in the South African construction industry.

2 Literature Review

Oyediran and Akintola (2011) noted that African countries such as South Africa and Nigeria lack comprehensive technological development and standards which affect the use of the system with all tendering participants on board. Construction practitioners are also lacking the initiative in changing practice to embrace e-tendering for the procurement of a project (Eei *et al.*, 2012:17). Poole (2010) argued that Supply Chain Management (SCM) is the management of interconnected businesses involved in the manufacturing of a product or service required by customers. Poole (2010) continue to state that construction supply chain management consists of the planning and management of all construction activities involved in sourcing, procurement, monitoring and logistics management. Procurement as related to construction is

a step-by-step process that typically involves; determining project criteria, setting contractual framework, setting tender and adjudication processes, inviting tenders and finally award of tender (Masunda, 2014:2). In simple definition, procurement also means how to execute a project. This definition shows e-tendering is a crucial section of the procurement system. Black, Rong and Gonzalez (2005) according to the findings proposed a typical e-tendering process generally engaged by most systems which include Pre-qualification and registration, Public invitation, Submission of tender, Close of tender, Evaluation of tender, Award tender and Archiving. The above mentioned processes will facilitate the successful completion of a project. The effectiveness and factors affecting the wide use of e-tendering cut across the above listed processes. E-tendering is receiving more attention these years most especially as an isolated solution to problems related to traditional tendering system (Jacobsen and Koch, 2013). The need to have a secured, simple, standard, efficient, cost effective and curbing corruption stems governments of many African countries to adopt and implement e-tendering. Despite the benefits (both managerial and administrative) e-tendering offers to the procurement of construction projects in the South African construction industry, there are still several put offs in the South African construction industry (Oyediran and Akintola 2011:561). The examination of these put offs is what this study is all about.

From the literature review conducted by Laryea and Ibem (2014) few empirical studies have been done on the barriers to e-procurement in the AEC industry. Laryea and Ibem (2014) proceeded to set South African construction industry as an example, the magnitude of barriers to e-procurement up-take has not been examined and properly put into words in the literature; leading to inadequate understanding of the factors that affect the wide use of e-tendering in the construction industry of this country. Prior to the implementation of e-tendering into any construction industry worldwide, electronic readiness need to be investigated and the level of e-readiness among individual, societies, companies and nations should be critically examined (Cheon, 2007). World Information Technology & Service Alliance (WITSA) stated that e-ready country requires end user trust in e-commerce security & privacy, improved security technology, well trained workers & low training costs, minimal restrictive public policy, latest business environment and reduced costs for e-tendering technology. Drawing from the survey conducted by Laryea and Ibem (2014) and relating the survey findings to the standards established by WITSA, it could be vividly seen that the ICT environment in developing countries are not e-ready for the wide use of e-tendering into the operations of the construction industry. Lavelle and Bardon (2009) concluded based on his findings that there is existing recognition of the benefits but several factors affecting the wide use of e-tendering are presently responsible for the slow uptake and limited use of e-tendering.

3 Research Methodology

This section emphasizes the method used in this study. Owing to the nature of research topic, quantitative research methodological approach was adopted which embraces literature findings and industry based questionnaire survey. The research instrument suitable for this study is the questionnaire survey which was prepared and designed according to the Tshwane University of Technology ethical committee. Data are obtained through the use of survey questionnaire amongst construction practitioners actively involved in the planning of construction projects and the researcher distributed the questionnaire via hand and email. Random sampling technique was used during the data collection stage of the study. The professional Association within the South African construction industry (South African Institute of Civil Engineers SAICE, Engineering Council of South Africa ECSA, The South African Council for the Project and Construction Management Professions SACPCMP, and Association of South African Quantity Surveyors ASAQS) serve as the data base for this study. The descriptive analysis was conducted to analyse and interpret data collected. The statistic package for social science

(SPSS) was used to analyse collected data. The descriptive analysis used in this study comprises of frequencies test, percentages, standard deviation and mean.

4 Data Collection

The primary data adopted in this research were acquired and collected via the administering of a structured industry based questionnaire to construction practitioners within the Tshwane Districts of Gauteng Province of South Africa. Total numbers of 80 questionnaires were distributed to construction practitioners and of these 80, 56 were returned, showing a response rate of 70%. From the questionnaires returned, 5 were unusable as information supplied was non-conforming to require standards and some had incomplete data. The questionnaires were passed out by hand (hardcopy) and via email (soft copy). This was facilitated as follows:

1. The questionnaires were sent via email to the sample population and were supported with introductory letter.
2. Reminder emails were sent to the targeted respondents who did not return the questionnaire after two weeks.
3. Another reminder email was sent to the respondents who did not return the questionnaire after two weeks.
4. The researcher made sure the questionnaires administered by hand were returned immediately after completing the questionnaire, they were picked up by the researcher.

5 Summary and Research Findings

The survey questionnaire was used for data collection. A five point likert scale ranging from not suitable to extremely suitable was used to determine the building procurement method best suitable for the use of e-tendering. Also a five point likert scale ranging from strongly disagree to strongly agree was used to determine the challenges of traditional tendering system, factors affecting the wide use of e-tendering and challenges of e-tendering infrastructures. Finally a five point likert scale ranging from never to always was used to measure the awareness level of e-tendering amongst construction practitioners in the Tshwane district of Gauteng Province.

5.1 Factors affecting the wide use of E-tendering

This section was based on a 5 point Likert scale ranging from 1-strongly disagree to 5-strongly agree. The descriptive analysis was used to indicate how respondents answered the questions relating to the factors affecting the wide use of e-tendering. The average of answers for each construct was given by the mean as indicated in Table 1. Furthermore, the standard deviation indicates how much variation occurred from the average mean. A high standard deviation indicates that the data is spread across a large range of values, while a low standard deviation indicates that the data points tend to be very close to the mean.

Table 1. Descriptive statistics of factors affecting the wide use of E-tendering

	Descriptive Statistics						
	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
People are intimidated by technology	51	1.00	5.00	3.7647	1.19312	-.773	.333
Lack of awareness	51	2.00	5.00	4.2941	.75615	-.844	.333
No quantifiable measures/ indicator of success	51	1.00	5.00	3.1373	1.07740	.116	.333
Poor Cross Communication between stakeholders	51	1.00	5.00	3.0000	1.14891	-.494	.333
Misunderstanding within the fragmented supply chain management system	51	1.00	5.00	3.1569	1.08393	-.815	.333
Inadequate Industry standards for sharing information.	51	1.00	5.00	2.6471	1.09222	.374	.333
Once-off nature of construction projects	51	3.00	5.00	4.5882	.53578	-.773	.333
Low awareness level of government policy guidelines for e-tendering within construction industry	51	1.00	5.00	3.4902	.98737	-.620	.333
No quantify information technology systems	51	1.00	4.00	2.5490	.85589	-.357	.333
Limited Internet coverage for all geographical regions	51	1.00	5.00	3.1961	.98020	-.810	.333
E-tendering portal is not user friendly	51	1.00	5.00	2.2353	1.25838	.537	.333
Difficult to convert paper base documents	51	1.00	5.00	3.6275	.89355	-1.276	.333
Limited knowledge of legal and security policies	51	1.00	5.00	3.3333	.86410	-.330	.333
Limited Human Resources and operators	51	3.00	5.00	4.1373	.40098	1.149	.333
Financial resources for	51	1.00	5.00	4.0588	.73244	-2.635	.333

initial installation of e-tendering infrastructures								
Not all Forms of contracts used in the construction industry is e-tendering supportive	51	1.00	5.00	3.5098	1.02708	-.719	.333	
Low level knowledge about e-tendering benefits	51	1.00	5.00	3.3922	1.04074	-.864	.333	
Inadequate e-tendering infrastructure	51	1.00	5.00	2.9412	1.02785	.236	.333	
Total average mean	51	2.00	4.00	3.4314	.53870	-.116	.333	
Valid N (listwise)	51							

The conducted analysis on the factors affecting the wide use of e-tendering as shown in the table 1 presents the results that indicated people Intimidation by technology, lack of awareness, once-off nature of construction projects, difficulty in converting paper base documents, limited Human Resources, financial resources for initial installation and contracts that are not in support of e-tendering resulted in an average mean ranging between 3.5 and 4.7. The mean values were 3.7647, 4.2941, 4.5882, 3.6275, 4.1373 and 4.0588 respectively. The result shows that participants are in agreement on the factors affecting the wide use of e tendering. Once-off nature construction projects had the highest mean of 4.5882, which shows that participants strongly agree that once off nature construction project is the main factor affecting the wide use of e-tendering. The following are disagreement among the participants in this study: unquantifiable measures, poor cross communication, misunderstanding, government policy, inadequate industry, inadequate quantified information technology, limited internet, limited knowledge of legal and security policies, low level knowledge about e-tendering and inadequate infrastructure had their mean values oscillating between 2.5 and 3.4. Furthermore, the average mean for portal not user friendly is 2.2353 which suggest that most participants strongly disagree to e-tendering system are not user friendly. The study also investigated the collected mean of all factors affecting the wide use of e-tendering (Total average mean), the results in the table 1 show that the mean value is 3.4314, this value is equivalent to 3 when rounded off to the nearest whole number. This means, not all investigated factors affects the wide use of e-tendering in the South African construction industry.

5.2 E-tendering infrastructures

Table 2 shows the descriptive statistics of challenges of e-tendering infrastructure. The results show that the average mean of e-tendering Server Operating system hinders tenderers from submitting tenders and tenderers do not get confirmation after submitting tenders was below an average mean of 3.000 with the following values respectively; 2.2549 and 1.9804. While with Portal does not support all formats of tender documents, poor data control and management of data Traffic, High internet connectivity rate to operate e-tendering portals, Have difficulties accessing and updating submitted tenders and Issuing the same login details to more than one tenderers, their average mean was 2.9020, 3.2353, 3.0588, 3.3529 and 3.1569. These mean values indicate that participants are generally neutral and unsure to the following questions: Portal does not support all formats of tender documents, poor data control and management of data Traffic, High internet connectivity rate to operate e-tendering portals,

Have difficulties accessing and updating submitted tenders and Issuing the same login details to more than one tenderers. On the other hand; submission of tender do not reflect on the e-tendering portal, limited trained technical staff with ICT support skills and no knowledge on electronic signature capturing and encryption system had an average mean of 3.8824, 4.2157, and 3.8235. This means most of the participants agree to the listed questions above. The total effect of challenges of e-tendering infrastructure was computed, and its average mean was found to be 3.3333 which means generally all respondents are evenly distributed around the neutral to e-tendering having challenges with infrastructure.

Table 2. Descriptive statistics of Challenges of E-tendering Infrastructure

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error
Submission do not reflect on e-tendering server	51	1.00	5.00	3.8824	1.03242	-1.005	.333
Management of data traffic	51	1.00	5.00	2.9020	1.00509	-.166	.333
Server Operating system hinder tenderers from submitting tenders	51	1.00	5.00	2.2549	1.05533	.417	.333
Tenderers do not get confirmation after submitting tenders	51	1.00	5.00	1.9804	1.17457	.964	.333
Limited training technical staff	51	1.00	5.00	4.2157	.94475	-1.491	.333
e-tendering portal does not support all formats of tender documents	51	1.00	5.00	3.2353	1.25838	-.152	.333
High internet connectivity rate	51	1.00	5.00	3.0588	.92546	.038	.333
Little knowledge on electronic signature capturing	51	2.00	5.00	3.8235	.88783	-.174	.333
Tenderers have difficulties accessing and updating submitted tenders	51	1.00	5.00	3.3529	1.23002	-.317	.333
Issuing the same login details to more than one tenderers	51	1.00	5.00	3.1569	1.20619	-.385	.333
TChalETenderingInfrastructure	51	2.00	5.00	3.3333	.65320	-.017	.333
Valid N (listwise)	51						

5.3 Awareness level of E-tendering

The results of Table 3 illustrates that a good number of 52.9% of respondents are aware of e-tendering, this is followed by 23.5% of the respondents who rarely know e-tendering. 17.6% of the respondents frequently know e-tendering. These results show that more than half of the respondents are quite aware of e-tendering.

Table 3. Awareness of E-tendering

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Never	1	2.0	2.0	2.0
	Rarely	12	23.5	23.5	25.5
	Occasionally	2	3.9	3.9	29.4
	Frequently	9	17.6	17.6	47.1
	Constantly	27	52.9	52.9	100.0
	Total	51	100.0	100.0	

Figure 1 below shows the distribution of the respondent's awareness to e-tendering, and it is clear that more respondents are aligned to the right of the graph which shows that majority of the participants who participated in the study are aware of e-tendering.

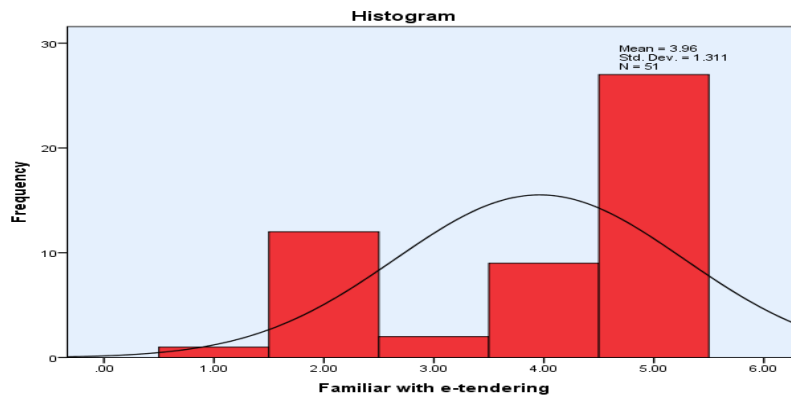


Figure 1. E-tendering awareness

6 Conclusion and Recommendations

6.1 Factors affecting the wide use of e-tendering

The following conducted analysis on the factors affecting the wide use of e-tendering indicates that:

- people are Intimidated by technology,
- lack of awareness,
- once-off nature of construction projects,
- difficulties in the conversion paper base documents to electronic formats,
- limited Human Resources and operators of e-tendering portals,
- financial resources for initial installation of e-tendering infrastructures, and
- Not all forms of contracts supports the use of e-tendering.

Based on the above listed factors, participants agreed that these factors are responsible for the limited use of e-tendering. Once-off nature of construction projects rank the highest factor that affect the wide use of e-tendering. In spite of these factors identified, the prospect of e-tendering in the South African construction industry is high. This could be assumed true since all the factors identified can be eradicated or managed without posing serious obstacle to the wide use of e-tendering. The only factor which seems to be inevitable is the once-off prototype of construction projects.

6.2 Challenges with E-tendering infrastructures

The basic infrastructures necessary for e-tendering are computer hardware, computer software, the internet connectivity and the human resources (operator). This study critically examined these infrastructures to obtain findings based on the challenges of e-tendering system as these challenges will affect the wide use of the system.

From the investigation conducted around the e-tendering infrastructures, results shows that the following challenges have been encounter by construction practitioners who have being used the e-tendering in the tendering stage of construction projects:

- submission of tender do not reflect on the e-tendering server,
- limited trained technical staff with ICT support skills,
- no knowledge on electronic signature capturing and encryption system,
- e-tendering portal do not support all forms of tender documents,
- tenderers have difficulties accessing and updating submitted tenders.

Of all the identified challenges of e-tendering infrastructures, limited trained technical staffs with ICT support skills and construction practitioners having no knowledge on electronic signature capturing system and encryption system were seen to be the most important challenges of the infrastructures. The signature capturing and encryption is very important in electronic transaction as it serves as a means of authenticating exchanged documents between construction stakeholders.

High level of trained technical staff with ICT skills proficient skills in signature capturing system and encryption system is required in order to increase the wide use of e-tendering system amongst construction practitioners.

6.3 Awareness level of e-tendering

According to the finding obtain from the survey conducted around the awareness of e-tendering in the South African construction industry, the result illustrates that a good number of participants are fully aware of e-tendering system and benefits that can derive from the wide use of the system. Specifically 52.9% of the participants are adequately aware of e-tendering while the other participants are not well knowledgeable of the e-tendering system. With this level of awareness amongst construction practitioners e-tendering is definitely gaining attention and this will eventually lead to the wide use of the system in the nearest future.

Though it is evidential that significant numbers of the participants are adequately knowledgeable of e-tendering the usage of the system is notably elementary. Practitioners in the quantity surveying profession have participated in the use of e-tendering than any other practitioners. It is confidently seen that the quantity surveyor are more aware of the e-tendering system than other stakeholders in the South African construction industry.

Based on the research findings the following recommendations are suggested by the researcher:

- Proper briefing on the use of e-tendering should be done during the planning stages of construction projects.
- The adoption of e-tendering, training, education and support from senior management are important requirements for the effectiveness of the system.
- Government being the largest construction clients should develop more competent e-tendering platforms and enforce the use of e-tendering.
- The sales of e-tendering infrastructures especially the software infrastructure monopolised in order to reduce purchase price and installation.
- Effective means of communication should be established to minimise the fragmented nature of the industry.

7 References

- Black, P., Rong, D. and Gonzalez, J. (2005) E-tendering – Security and legal issues: Research Report, Research number: 2002-067-A, published by CRC Construction Innovation, January 2005.
- CHILIPUNDE, R. (2013) Electronic tendering in Malawian construction Industry: the dilemmas and benefits. *Journal of Modern Education Review*, ISSN 2155-7993, USA. Vol. 3. No. 10, pp. 791-800. Available from: <http://www.academicstar.us>. [Accessed date: 22nd April 2015].
- Choen Weng Lou E, and Alshawi, M. (2009) Critical success factors for e-tendering implementation in construction collaborative environments: People and process issues, *Journal of Information Technology in Construction (ITcon)*, Vol. 14, pg. 98-109.
- Connell, L. Electronic Tendering: Recognising a More Effective Use of Information Communications Technology in the Irish Construction Industry, submitted in fulfilment

- of Magister degree (M.Sc.) at Dublin Institute of Technology, January 2010. [Accessed date: 12/01/2015].
- Eei, K.S. Husain, W. and Norlia, M. (2012) Survey on Benefits and Barriers of E-Procurement: Malaysian SMEs Perspective. *International Journal on Advanced Science Engineering Information Technology*, Vol.2, p. 14-19.
- Jacobsen, K. and Koch, C. (2013) E-tendering - an emerging design- construction IT-bridge. *Journal of Construction Engineering and Management*, 29(4): pp. 578-585.
- Kajewski, S. and Weippert, A. (2004) E-tendering: Benefits, Challenges and Recommendations for practice, published by QUT, in proceedings CRCCI International Conference: Clients Driving Innovation, surfers Paradise, Australia.
- Laryea, S. and Ibem, E. (2014) Barriers and prospects of e-procurement in the South African construction industry. Research paper: school of construction and management, University of the Witwatersrand, Johannesburg, South Africa.
- Lavelle, D. and Bardon, A. (2009) E-tendering in construction: time for a change. *Built Environment Research Papers*. Vol. 2 No. 2, 2005, pp.104-112.
- Mohamad, R., Abdul, R H., Zulaiha, A O. and Maizura, M N. (2010) Decision Support Systems (DSS) in Construction Tendering Processes. *International Journal of computer science*, Vol. 7, no. 1, March 2010.
- Oyediran, S O. and Akintola, A A. (2011) A survey of the state of the art of e-tendering in Nigeria, *Journal of Information Technology in Construction (ITcon)*, Vol. 16, pg. 557-576.
- Poole, C.W. (2010) Supply chain principles and applications. HEFMA conference. University of Kwazulu Natal, South Africa.
- Vee, C. and Skitmore, C M. (2003) Professional Ethics in the Construction Industry. *Engineering, Construction and Architectural Management*, Vol. 10 (2), pp. 117-127.
- World Information Technology and Services Alliance (WITSA) (2004). The WITSA public policy report 2004, 2004, WITSA, Geneva.

THE ASPECT OF LABOUR IN HYBRID AND IN-SITU CONCRETE CONSTRUCTION IN SOUTH AFRICA

Schreuder, Jan-Hendrik Michiel; Wium, Jan Andries

Department of Civil Engineering, Stellenbosch University, Stellenbosch, Western Cape, South Africa

Abstract

In this research programme labour has been identified as one of the aspects of the decision-making process between in-situ and hybrid concrete construction (HCC). The construction industry is ranked as the employer with the fifth highest number of employees in South Africa, which is currently experiencing a 25.4% unemployment rate. This highlights the importance of the construction industry as an employer in South Africa. Labour is considered as one of the areas of highest concern in the South African construction industry. This concern is intensified when the shortage of skilled labour in the industry is taken into account. A labour hour comparison between an in-situ and HCC project were conducted to provide information regarding the amounts and types of labour used in both construction techniques. The comparison showed that HCC employs low-skilled labour more effectively and in larger percentages of total labour than the in-situ alternative. However, the in-situ alternative is better for job-creation considering the total number of employment opportunities. Nevertheless, the HCC alternative has a quicker return rate due to shorter construction periods, therefore labourers are available at an earlier stage for employment on subsequent projects. It is recommended that the use of HCC be promoted to employ larger percentages of low skilled workers and to improve product delivery durations.

Keywords: Hybrid concrete construction, Labour, In-situ concrete

1 Introduction

Hybrid concrete construction (HCC) is a construction technique combining precast concrete elements and in-situ concrete by making use of the best attributes of each to construct buildings and other structures. Several factors can play a role when a decision is required for the most appropriate construction technique to be used on a project. Projects teams need to consider the effect of time and cost, construction safety and quality, technical capability of the designers and contractors, aesthetics, sustainability and labour related issues. This research investigated specifically the aspects of labour and how this would be impacted by a choice for a construction method. The objectives of the study were thus to make a comparison between the two construction methods by considering the types of labour and labour hours spent on each.

2 Literature Review

Precast elements are manufactured in a controlled environment, enabling the production of higher quality products than in the in-situ environment (Elliott, 2002). The controlled environment enables project parties to provide a safer environment for the workforce and to give them better job security (Lombard, 2011). South Africa strives to create 11 million jobs by 2030 (National Planning Commission, 2013). These job creation schemes are described by the *National Development Plan* (NDP). This programme has a direct influence on the

construction industry as it is expected from construction companies and other labour-based industries to provide job opportunities to the unskilled and unemployed labour market. Civil construction projects are ranked amongst the best areas to promote good economic growth and to create job opportunities since it is considered as a labour-intensive environment (National Planning Commission, 2013). Interviews with individuals from the South African construction industry concluded that job creation is considered as one of the barriers for the implementation of HCC in South Africa (Schreuder, 2015). Considering the NDP, in-situ construction may provide more employment opportunities, but it is of a more temporary nature than that of HCC projects. Also, according to (Piek, 2014), in-situ concrete construction requires skilled labour, making the use of unskilled temporary labourers a concern for meeting quality requirements.

The *Expanded Public Works Programme* (EPWP) provides a platform to carry out the projected milestones of the NDP. This programme also strives to promote skills development at a sub-programme level, as they are familiar with the current low skills of labourers in South Africa (Department of Public Works, 2013). Considering the objectives of the NDP and EPWP regarding job creation and skills development, HCC does not seem as the ideal solution upfront as it is often postulated to utilize fewer labourers and also for a shorter period (Irish Concrete Federation, 2014). Information on the extent and type of labourers used in this environment will provide relevant support regarding the validity of this opinion. For this reason an investigation was carried out to investigate these aspects of labour by means of a case study.

3 Research Methodology

3.1 Techniques

This study made use of several techniques to satisfy the required research objectives. It was decided to divide the study into two sub-divisions. These were:

Socio-economic aspects of labour in both construction techniques.

Labour productivity and its effect on both construction techniques.

The research process of this study is based on triangulation, which is defined as the use of two or more points of reference to enhance the accuracy of findings. The following paragraphs give a brief description of the research methods applied.

A literature study was first conducted, combining international and local information regarding this investigation to gain background knowledge and to guide the remainder of this study. Semi-structured interviews were also performed involving representatives from various organisations in the South African construction industry. These interviews served as the primary data source regarding socio economic aspects of labour in both construction techniques. It also served as guideline for the set-up of the case study. Ten individuals were interviewed and were asked similar questions. Asking similar questions to various people provides a good point of reference and gives a better understanding of the topic.

Site visits were conducted to enrich the researcher's practical knowledge regarding the two construction methods under consideration. These visits were conducted at the following construction sites:

- In-situ construction sites: New Panorama hospital building - (NMC)
- Hybrid Concrete Construction sites: CPUT hostel building - (NMC)
- Prefabricated elements manufacturing plants: Cobute, Concrete Units, Portland Hollowcore

In a case study a labour hour comparison between an in-situ and hybrid concrete construction project was done to investigate job creation in both the considered construction methods. According to the *Fundamentals of quantitative research*, quantitative methods are normally

used to test hypothesis and theories (Sukamolson, 2012). This labour hour comparison compares the labour hours of an in-situ building with a similar HCC building. The labour hours spent to manufacture the precast concrete elements used at the HCC project were also considered. The case study was conducted to help with the setup of the research. The interviews were mainly conducted with individuals from the construction companies providing the labour execution rates. A representative from the precast manufacturing industry was also interviewed to obtain labour hour rates regarding the precast concrete element manufacturing process.

Previous similar (construction related) qualitative and quantitative studies by Jin and Ling (2006) and Lam, Chan and Chan (2007) made use of surveys to successfully answer research questions (Jin and Ling, 2006; Lam, Chan and Chan, 2007). Furthermore, Chan and Chan (2004) also used semi-structured interviews to assist with primary data collection (Chan and Chan, 2004). In addition, research by Ogunlana (2010) determined how various participants on large-scale construction projects perceive performance on projects, by using both semi-structured interviews (a total of 35 interviewees) and a survey questionnaire (a total of 76 respondents).

3.2 Case study

The following paragraphs provide information on the case study.

3.2.1 Structural systems and projects used in this comparison

The structural systems used in the case study were a function of the availability of data from the individuals interviewed for this case study. The construction company which provided the researcher with the labour hour rates of execution predominantly use hollow core floor slabs on loadbearing brick walls in their HCC projects. In their in-situ projects they predominantly use the first two techniques shown in Figure 1.

Project-specific labour hours of activities for post-tensioned flat slabs and conventional flat slabs on in-situ concrete columns as shown in Figure 1 were obtained through site visits and through meetings with the project manager and quantity surveyor of an example project. Information regarding the labour hours of a hybrid concrete construction project was also gathered through meetings with the on-site project manager and quantity surveyor and through a meeting with the director of an anonymous precast manufacturer in South Africa.

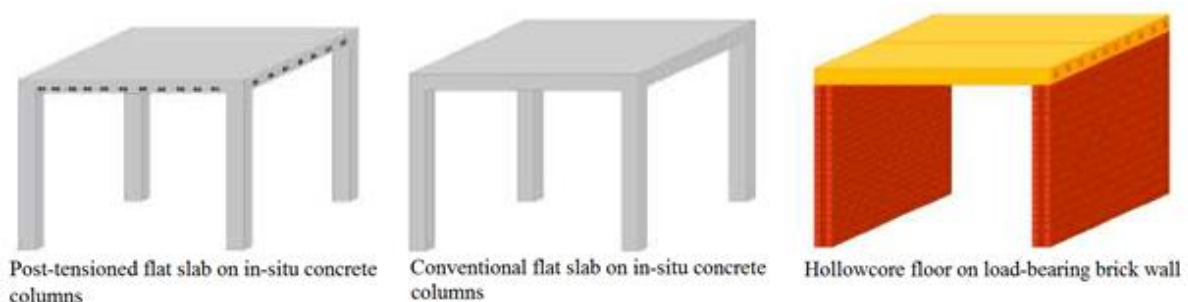


Figure 1. Structural systems used in this case study (Lombard, 2011)

In order to enable a labour hour comparison between the two construction methods, similar in-situ and HCC projects had to be compared. Information for a HCC project was available, but an in-situ replica of the HCC project was not.

A construction company was able to provide the rates of an HCC four storey student residence building. The building was constructed using loadbearing masonry walls with hollow core floor slabs, as shown by the third concept in Figure 1. The floor plan of the student residence building is shown in Figure2.

For the in-situ building improvisation was required. This was done using the available in-situ construction rates from the construction of a multi-storey hospital building. The project manager of the in-situ project was able to provide the construction rates of execution for the two in-situ structural systems shown in Figure 1 **Error! Reference source not found.** It was decided to use these rates as basis for the in-situ project and to apply them to an in-situ concept of the HCC example project. This was possible, as the spans between supports of the in-situ design could be applied to the HCC design.

By conceptually placing columns in the residence building as shown in Figure 3, a floor span configuration reasonably similar to that of the hospital building could be obtained. Also, the floor loadings of imposed load and masonry walls would be reasonably similar. By applying the in-situ execution rates (from the hospital building) to the configured residence building (Figure2), it provided an in-situ alternative for comparison with the HCC example building.

Due to the symmetrical design of the residence building, Figure2 only shows one half of the in-situ structural concept of the residence building. It is important to note that the masonry walls for the in-situ design of the residence building is non-loadbearing and all the inner walls are single-layered, which is similar to the hospital concept from where the in-situ execution rates were obtained. On the other hand, the outer brick walls of the HCC design are loadbearing together with the thicker inner walls which are also double-layered loadbearing walls.

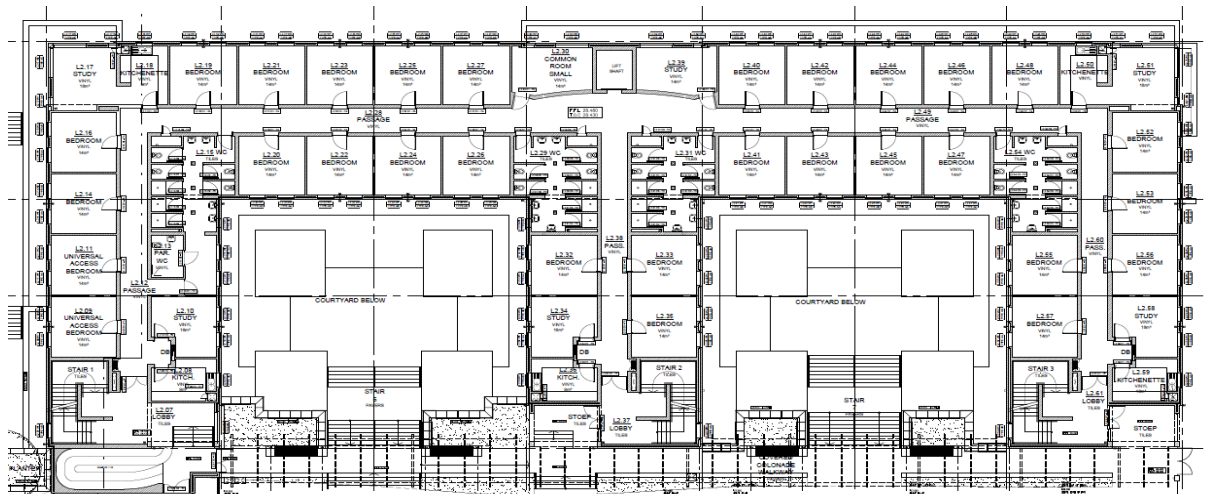


Figure 2. Original floor plan of the HCC student residence building

Both projects were constructed by the same construction company in the same year. This ensured minimal labour execution rate fluctuations between the two considered projects. The precast floor slabs used in the HCC project were manufactured using the extrusion process which is a highly mechanized manufacturing process. The precast manufacturer who provided the precast element manufacturing rates is a well-recognised hollow core floor slab manufacturer in South Africa, which contributes to the reliability of the rates.

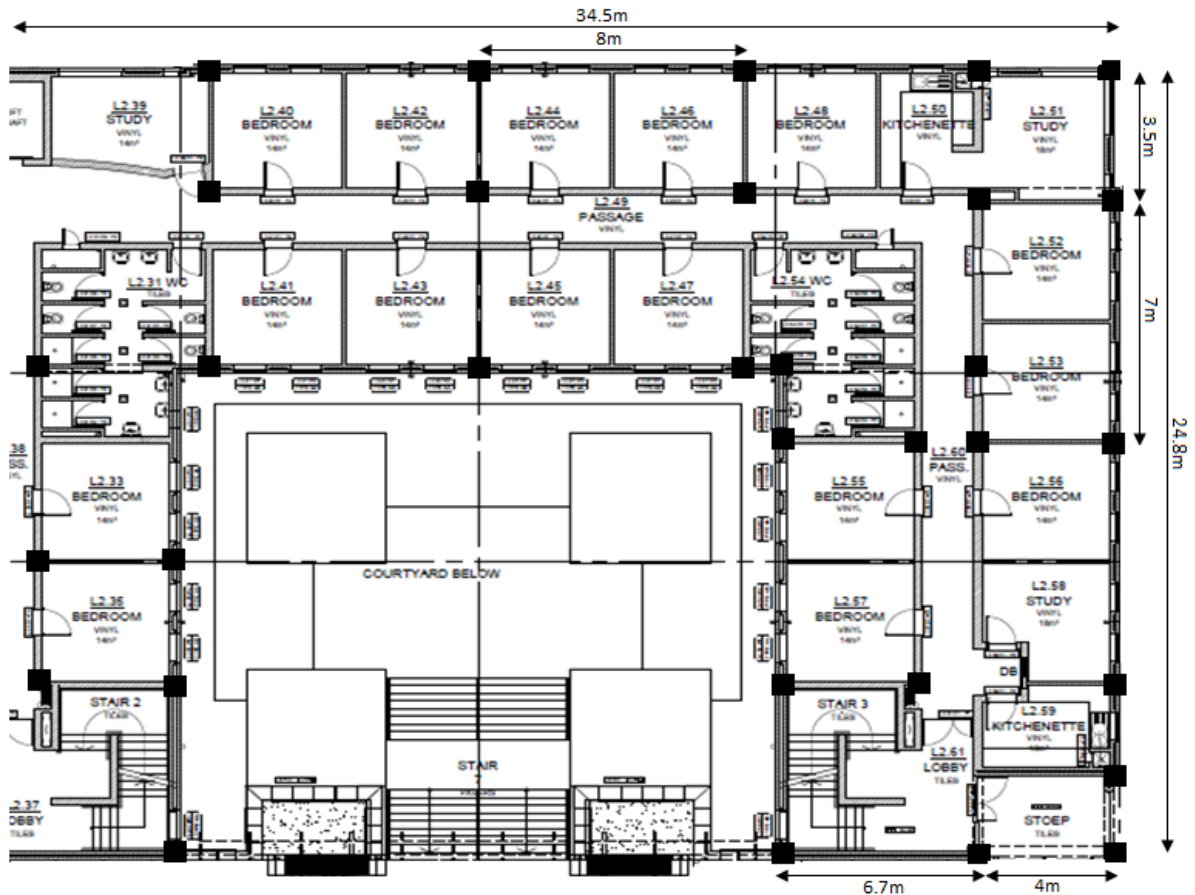


Figure 3. In-situ structural concept of student residence building

4 Findings and Discussions

The labour hour case study was carried out on a project in the structural building industry, and conclusions drawn are therefore only applicable to this industry. The comparison provides relevant information on the construction technique which best promote job creation according to the EPWP as well as the technique which best suit the current labour environment of the South African construction industry.

4.1 Labour rate estimates

The labour rates of execution as received from the project managers of both projects were a function of the labour teams used. These execution rates were simplified to units per hour for a corresponding labour team, where the unit is a function of the type of activity.

The in-situ construction unit rates from the hospital project, with the corresponding labour teams as obtained from the project managers, are shown in Table. Table 2 shows the HCC rates of the student residence building with the corresponding labour teams.

The execution rates of the precast manufacturing plant and related labour teams are shown in Table 3. This information was obtained from an interview with the director of a precast manufacturing plant.

Table 1. In-situ construction labour rates with corresponding labour teams (Hospital building project)

Activity		Unit rates for each activity			Related labour teams			
		Rate of execution	Production Unit	Supervisor	Operator	Skilled	Semi-skilled	General labour
Columns	Erect formwork	24.19	m ² /h	1	-	-	2	4
	Re-bar	1.57	m ³ /h**	1	-	-	3	-
	Cast concrete	4.18	m ³ /h	1	-	-	1	2
	Dismantle formwork	30.24	m ² /h	1	-	-	-	4
Deck (Flat slab-250mm)	Erect formwork	15.63	m ² /h	1	-	-	5	8
	Stop-ends	50.00	m ² /h	-	-	-	2	-
	Re-bar	20.83	m ² /h	1	-	-	10	-
	*Install post-tensioned cables	2.63	cables/h	1	-	-	6	-
	Concrete placement	25.00	m ³ /h	1	-	-	2	6
	Powerfloating (concrete)	83.33	m ² /h	-	-	3	-	-
	Curing compound (concrete)	166.67	m ² /h	-	-	-	-	2
	Remove stop-ends	62.50	m ² /h	-	-	-	-	4
	*Stressing of post-tensioned cables	4.20	cables/h	1	-	-	3	-
	Strip formwork	20.83	m ² /h	1	-	-	-	6
Masonry Walls	Single layer	14.42	m ² /h	1	-	-	10	6
	Double layer	7.21	m ² /h	1	-	-	10	6

Note: For the deck, the rates for the stop-ends and the re-bar are given as per the area of the floor

* Activities only related to the post-tensioned (PT) flat slab alternative

** The rebar for the column is given as the volume of concrete reinforced per hour

4.2 Employment opportunities in both environments

4.2.1 Legislation requirements

HCC does not seem as an ideal construction method in South Africa due to the reduced labour requirements as shown in Table 4. However, programmes such as the EPWP and NDP do not restrict the use of HCC in the structural building environment.

In the case where a project in this environment is subject to the EPWP, the only activities required to be done using labour intensive techniques are the excavation of foundation trenches by hand and the manufacturing of masonry elements on site (Department of Public Works, 2012). Both these activities can thus be done in a labour intensive manner, even when using HCC as a construction alternative.

Table 2. HCC on-site labour rates with corresponding labour terms (Student residence project)

Unit rates for each activity		Related labour teams						
Activity		Rate of execution	Production Unit	Supervisor	Operator	Skilled	Semi-skilled	General labour
Deck (Structural topping -60mm)	Precast element placement							
	Formwork to edges	50.00	m ² /h	1	-	-	2	4
	Props	62.50	m ² /h	-	-	-	2	2
	Mesh instalment	20.58	m ² /h	-	-	-	-	4
	Concrete placement	12.43	m ³ /h	1	-	-	2	6
	Powerfloating (concrete)	83.33	m ² /h	-	-	3	-	-
	Curing compound (concrete)	166.67	m ² /h	-	-	-	-	2
	Strip formwork	2.25	m ² /h	1	-	-	-	4
	Strip props	62.50	m ² /h	-	-	-	-	4
Masonry Walls	Single layer	14.42	m ² /h	1	-	-	10	6
	Double layer	7.21	m ² /h	1	-	-	10	6

Note: The rates for the formwork to the edges and for the props are given as per the area of the floor

Table 3. Labour manufacturing rates at precast plant

Unit rates for each activity		Labour teams					
Activity		Rate of execution	Production Unit	Supervisor	Operator	Semi-skilled	General labour
Production	Cable placement and stressing						
	Casting	130.00	m ² /h	1	4	-	4
Stripping	Measure and cutting	130.00	m ² /h	1	2	4	-
	Removal from cast bed	65.00	m ² /h	-	1	-	4
	Move from stockyard onto truck	65.00	m ² /h	-	1	-	4

Note: All the rates in Table 3 are given per area of the floor

4.2.2 Labour hour comparison

A labour hour comparison between the three alternatives shown in Figure 1 was conducted. The comparison relies on the labour hour rates as received from the project managers and the quantity surveyors.

The floor slab is the only structural element constructed using precast elements in the HCC alternative. Therefore, this activity will be compared in isolation. The labour requirements for the HCC alternative are 1385.6 hours (1030.3 + 355.3), while the conventional method requires 3117.3 hours. This indicates a 55.6% reduction in labour for the construction of the floor slab when using HCC. However, in the structural building industry, all the components are rarely constructed using only precast elements, therefore considering the construction of all the components will provide a better indication of the labour requirements for both techniques.

Table 4. Labour requirements in different construction alternatives

Labour requirements, in man hours per floor level			
Activities group	In-situ concrete construction		Hybrid concrete construction
	Post-tensioned floor slab	Conventional floor slab	Precast floor slabs and bearing walls
Walls	1898.3	1898.3	2397.3
Columns	377.4	377.4	-
Floor slabs (on-site)	2805.7	3117.3	1030.3
Floor slabs (plant)	-	-	355.3
Total	5081.5	5393.1	3782.9

Considering the total labour requirements as shown in Table 4, it is evident that HCC only requires between 70.1% and 74.4% of the labour force used in the two in-situ alternatives. This comparison includes the floor system, floor supports and supporting walls. Thus, considering the labour requirement reduction of the HCC alternative, it follows that this alternative is more labour effective since it uses less labour to construct the same building (Table 5). However, referring to these values, the use of HCC implies loss of employment opportunities which is considered as a disadvantage considering the current unemployment rate of South Africa. Although HCC utilizes less labour, it has a faster turnover, which means that labourers are available for new employment opportunities at an earlier stage. Another important factor to consider is the type of labour used in each alternative.

Table 5. Man hours required per square meter

Floor slab	Rate (Man hours/m ²)
In-situ (conventional)	4.68
HCC	3.28

4.3 Types of labourers used in both environments

The comparison of the types of on-site labour used in the in-situ and hybrid concrete construction projects, as provided by the project managers, will address the validity of the HCC technique to serve as solution for the current shortage of skills of South African labourers.

Table 6 shows the on-site labour skills breakdown of the construction of the floor systems shown in Figure 1 for the two construction types (In-situ and HCC). These values were compiled from the information obtained from Tables 1, 2 and 3. The labour information of the in-situ conventional floor system (Figure 1) were used for the in-situ construction type shown

in Tables 5 and 6, as this technique is more commonly used in South Africa than the post-tensioned (PT) flat slab system.

Table 6. On-site labour skills breakdown for the construction of the floor slab

Construction type	Labour skills						Total
	General		Semi-skilled		Skilled		
	Number	% of total	Number	% of total	Number	% of total	
In-situ	26	45.6	28	49.1	3	5.3	57
HCC	30*	75.0	6**	15.0	4	10.0	40

*Example - General labour (Table) 4+4+2+4+6+2+4+4 = 30

**Example – Semi-skilled (Table) 2+2+2 = 6

Note: Machine operators are considered as skilled

Note that supervision was not considered in this comparison as they were not considered as part of the workforce in the research. Also, the number of supervisors used in the considered techniques was relatively similar.

Table 7 shows the on-site labour hour breakdown of the various types of labourers. This comparison should be read together with the on-site labour skills breakdown shown in Table 6.

Table 7. On-site labour hours per type of worker

Construction type	Labour skills						Total
	General		Semi-skilled		Skilled		
	Hours	% of total	Hours	% of total	Hours	% of total	
In-situ	1004.5	36.2	1728.0	62.3	41.5	1.5	2774.0
HCC	713.5	80.5	94.1	10.6	78.3	8.8	885.9

Note: Supervisors were not considered in this comparison, therefore the total hours is less than that of Table .

The in-situ labour breakdown shown in Table 6 consists of 45.6% *general* and 49.1% *semi-skilled labourers*. Whilst for the HCC alternative, 75% of the labour consists of *general labourers*. Thus, the majority of HCC's labour force is low-skilled labour.

Table 7 shows that *general labour* conduct 80.5% of the work in the HCC alternative, whilst in the in-situ alternative, *general labour* only conduct 36.2% of the work. Also, important to note is that *semi-skilled labour* conduct 62.3% of the work in the in-situ alternative. Thus, the HCC alternative requires limited skilled and semi-skilled work on-site compared to the in-situ alternative.

Thus from the comparisons presented in Tables 5 and 6 HCC comes across as the ideal solution to the current low skills of labour in South Africa, as it largely relies on *general labour* to conduct the majority of the work.

5 Conclusion and Further Research

From the comparisons conducted in this case study it is concluded that HCC utilizes unskilled labour (conduct 80.5% of concrete work) to greater effect than how the in-situ alternative utilizes semi-skilled and skilled labour (conduct 63.8% of concrete work) considering the

productivity of each alternative as shown in Table 5. Thus, considering the effective use of unskilled labour in the HCC environment, this alternative can serve as the ideal solution for the current shortage work for un-skilled labour in South Africa.

It should be kept in mind that HCC creates less job opportunities considering the number of labour hours required for each alternative. However, more job opportunities can be promoted in the local communities as HCC utilizes higher percentages of unskilled labourers than the in-situ alternative. Nevertheless, considering the project as a whole, the HCC alternative would create less job opportunities in total. HCC would not be penalised for creating less job opportunities as tender requirements usually primarily encourage percentages of job creation amongst local communities. By promoting HCC more projects can be completed at a shorter delivery time providing higher percentages of low skilled employment opportunities.

6 Acknowledgements

The support of the anonymous individuals and construction companies who gave time and information to assist with this investigation is most appreciated.

7 References

- Chan, A.P. and Chan, A.P. 2004. Key Performance Indicators for Measuring Construction Success. *Benchmarking: an international journal*, Vol 11(2).
- Department of Public Works. 2013. EPWP Background Information. <http://www.epwp.gov.za/>, 2015, 2 February.
- Department of Public Works. 2012. EPWP Large Projects Guidelines. http://www.epwp.gov.za/documents/Infrastructure/Large%20Projects/EPWP_Large_Projects_guidelines.pdf, 2015, 20 February.
- Elliott, K. 2002. *Precast concrete structures*. Oxford, Elsevier.
- Irish Concrete Federation. 2014. *Benefits of precast*. [Online]. Available: http://www.irishconcrete.ie/benefits_of_precast.html [2015, 27 January]
- Jin, X. and Ling, F.Y.Y. 2006. Key Relationship-Based Determinants of Project Performance in China. *Building and Environment*, 41(7).
- Lam, E.W., Chan, A.P. and Chan, D.W. 2007. Benchmarking the Performance of Design-Build Projects: Development of Project Success Index. *Benchmarking: An International Journal*, 14(5).
- Lombard, A. 2011. Decision making between hybrid and in-situ concrete construction in South Africa. Stellenbosch: Stellenbosch University. MEng(Civil).
- National Planning Commission. 2013. National Development Plan Vision 2030.
- Ogunlana, S.O. 2010. Beyond the 'Iron Triangle': Stakeholder Perception of Key Performance Indicators (KPIs) for Large-Scale Public Sector Development Projects. *International Journal of Project Management*, Vol. 28(3).
- Piek, P.J. 2014. An Investigation into the Time and Cost Factors for a Decision between in-Situ and Hybrid Concrete Construction. Stellenbosch: Stellenbosch University. MEng(Civil)
- Schreuder, J.M. 2015. The aspect of labour in hybrid and in-situ concrete construction in South Africa. Stellenbosch: Stellenbosch University. MEng(Civil)
- Sukamolson, S. 2012. *Fundamentals of quantitative research*. Chulalongkorn University. Ph.D.

ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT OF INTELLIGENT BUILDINGS

Adio-Moses, David Adunadepo; Asaolu, Olumuyiwa Sunday
Department Of Architecture, University Of Lagos, Lagos, Nigeria

Abstract

This Study examines innovative ways of supporting the application of Artificial Intelligence (AI) to achieve sustainable development of intelligent buildings. On 25 September 2015, 193 countries of the UN General Assembly adopted a proposal on Sustainable Development Goals (SDGs) consisting of 17 goals with 169 targets as the 2030 Development Agenda titled ‘Transforming our world’. Goal 4 is Make cities and human settlements inclusive, safe, resilient and sustainable. Goal 5 is Take urgent action to combat climate change and its impacts. Massive population growth in slums, built environment degradation, pollution from industrialization and global warming in Africa must be addressed. The main aim of this study is to evaluate ways of using artificial intelligence combined with green architecture to achieve sustainable intelligent buildings in smart cities. The objectives include examining the relationships between Artificial intelligence, Nanotechnology, Lean Construction and Green Architecture. Methodology involves literature reviews on Artificial Intelligence and BIM with primary and secondary data collection on Green Architecture in Lagos. The Study found that green building materials were the main aspect of green architecture in use and prefabricated system of construction was the main aspect of Lean construction technique in use in Lagos. The Study recommends Integrated Project Delivery and Building Information Modeling (BIM). This study is important in that it provides information on intelligent buildings and Smart Cities that will combine advanced technology with green, Lean buildings to achieve the SDGs.

Keywords: Artificial Intelligence, Green architecture, Integrated Project Delivery, Intelligent buildings

1 Introduction

Building Automation refers to the use of computer and information technology to control building appliances and features as well as the advanced functionality provided by the control system of an automated building (Gerhart, 1999). A building that is controlled by a building automation system is often referred to as an intelligent building or a smart home/smart house (Wikipedia, 2013). ‘Smart’ planning of the urban environment has significant potential to improve quality of life and to reduce the carbon footprint of cities (Falconer and Mitchell 2012). Innovation can be viewed as the application of better solutions that meet new requirements, unarticulated needs, or existing market needs (Maranville 1992). Artificial intelligence (AI) in buildings is the intelligence exhibited by electronic devices and software driven systems which perceive their environment in buildings and take actions to optimize performance effectively within a given context or constraints. The central goals of AI research include reasoning, knowledge, planning, learning, natural language processing (communication), perception and the ability to move and manipulate objects. An intelligent building is a dynamic and responsive

Architecture that provides every occupant with productive, cost-effective and environmentally approved conditions through a continuous interaction among its four basic elements: places (fabric, structure, facilities); processes (automation, control, systems); people (services, users); and management (maintenance, performance) and the interrelation between them (Clements-Croome 2004). An intelligent building is one in which the building fabric, space, services and information systems can respond in an efficient manner to the initial and changing demands of the owner, the occupier and the environment. High performance, green buildings are energy and resource efficient, non-wasteful and non-polluting, highly flexible and adaptable for long term functionality; they are easy to operate and maintain, and are supportive of the productivity and wellbeing of the occupants (Traugott, 1999). An Intelligent building is a highly resource efficient, technologically advanced structure that provides a responsive support and effective environment for optimal performance and can accommodate future changes in use. The future drivers for intelligent buildings include information and communication technologies, robotics, smart materials, sustainable issues technology and social change. Building Energy Management System (BEMS) is an example of efforts aimed at achieving Artificial intelligence in intelligent buildings. The development of powerful microprocessors introduced Direct Digital Control (DDC) to building services and replaced analogue Electromechanical Devices. Nanotechnology is the engineering of functional systems at the atomic and molecular scale which involves manipulation of matter with at least one dimension sized from 1 to 100 nanometers thus giving people the ability to construct items from bottom up.

1.1 Problem Statement

The United States Green Building council (2016) states that the commercial and residential building sector accounts for 39% of carbon dioxide (CO₂) emissions in the United States per year, more than any other sector. U.S. buildings alone are responsible for more CO₂ emissions annually than those of any other country except China. Most of these emissions come from the combustion of fossil fuels to provide heating, cooling and lighting, and to power appliances and electrical equipment. By transforming the built environment to be more energy-efficient and climate-friendly, the building sector can play a major role in reducing the threat of climate change. Despite great advancement in technology for buildings, there is still a concern for global warming as buildings contribute significantly to pollution of the eco-system. It is therefore important that the use of advanced technology in buildings should be linked with sustainable development in line with SDGs.

This paper is important in that it examines support systems for Artificial intelligence in buildings as part of smart cities. This can help to minimize negative impacts such as built environmental degradation and global warming due to pressure from rapidly growing global populations.

1.2 Main objective

The main aim of this study is to evaluate ways of using artificial intelligence combined with green architecture to achieve sustainable intelligent buildings in smart cities. The objectives include examining the relationships between Artificial intelligence, Nanotechnology, Lean Construction and Green Architecture.

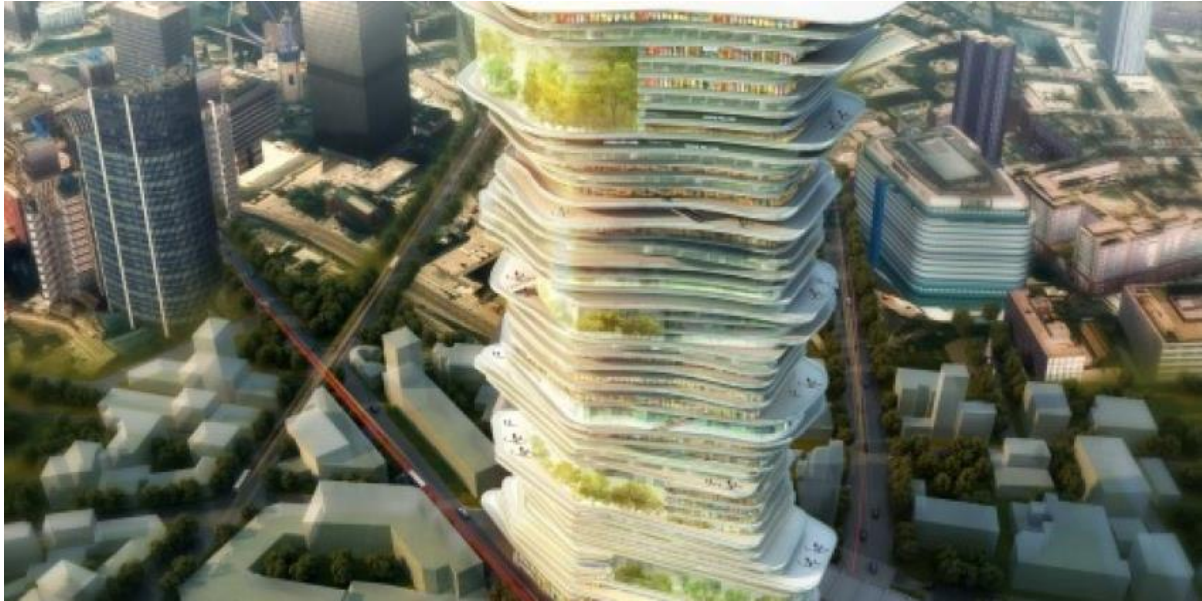


Figure 1. External view of the Endless City (Source: SURE Architecture Company, 2014)



Figure 2. Internal view of the Endless City (Source: SURE Architecture Company, 2014)

A good example where advanced technology is combined with sustainable development is “The Endless City”. The “Endless City” proposal drawn up by Beijing-based SURE architecture Company is a 300 meters tower in Shoreditch, England (see figures 1 and 2). The proposed structure, which won the super skyscrapers award in 2014, has two continuous ramps, or “streets”, spiralling up through the building, each lined with shops, apartments, parks and offices. Space between the ramps widens near the top of the building, letting in light and ventilation to filter down and save on energy costs, while rain water is collected and recycled.

Six big vertical tubes support the ramps and provide transport spaces for people, energy, waste, water and prefabricated modular steel elements for the skyscraper's ongoing growth.

2 Overview of Architectural Intelligence (AI)

The field of AI research was founded at a conference in the summer of 1956. AI involves the use of Machine perception – the ability to use input from sensors such as cameras, microphones, tactile sensors, sonar and others more exotic, to deduce aspects of the world; Computer vision – the ability to analyze visual input; Speech recognition, facial recognition and object recognition. Affective computing is the study and development of systems and devices that can recognize, interpret, process, and simulate human affects. These are aspects of AI for buildings. Intellectual capacities are grouped into practical, analytic and Creative. Hawking (2014) posits that success in creating AI would be the biggest event in human history and notes that it might also be the last, unless humans learn how to avoid the risks. Emotion and social skills play two roles for an intelligent agent or machine. First, it must be able to predict the actions of others, by understanding their motives and emotional states. This involves elements of game theory, decision theory, as well as the ability to model human emotions and the perceptual skills to detect emotions. Also, in an effort to facilitate human-computer interaction, an intelligent machine might want to be able to display emotions, even if it does not actually experience them itself in order to appear sensitive to the emotional dynamics of human interaction. A straightforward, specific task like machine translation requires that the machine read and write in both languages (Natural Language Processing), follow the author's argument (reason), know what is being talked about (knowledge), and faithfully reproduce the author's intention (social intelligence). In the 1990s, AI researchers developed sophisticated mathematical tools to solve specific sub-problems. These tools are truly scientific, in the sense that their results are both measurable and verifiable, and they have been responsible for many of AI's recent successes. The simplest AI applications can be divided into two types: classifiers ("if shiny then diamond") and controllers ("if shiny then pick up"). Controllers do, however, also classify conditions before inferring actions, and therefore classification forms a central part of many AI systems. A derivative of the Turing test is the Completely Automated Public Turing test to tell Computers and Humans Apart (CAPTCHA). As the name implies, this helps to determine that a user is an actual person and not a computer posing as a human. If research into strong AI produced sufficiently intelligent software, it might be able to reprogram and improve itself. The improved software would be even better at improving itself, leading to recursive self-improvement. The new intelligence could thus increase exponentially and dramatically surpass humans.

Quality Environment Fundamental Modules are Green Index, Space Index, Comfort Index, working Efficiency Index, Culture Index, High-tech Image Index, Safety and Security Index, Construction Process and Structure Index, Cost Effectiveness Index and Health and Sanitation Index. Four Main Aspects Of Hardware Components are – a- Facility management - Take care & maintain various functions for occupant comfort & operation; b- Information management - Office automation (OA), LAN, wiring; c- Communication - Tel/Fax, e-mail, video telecommunication and d- Control - DDC, building automation system. Common needs of intelligent building tenants include Built-in Internet wiring, LAN/WAN connectivity, Conduits for cabling, High-tech HVAC and Wiring for high-speed networks.

2.1 Nanotechnology for new building materials

Nanotechnology is taken as the scale range from 1 to 100 nm (National Nanotechnology Initiative) Materials reduced to the nanoscale can show different properties compared to what they exhibit on a macroscale thus enabling unique applications. For instance, opaque substances can become transparent (copper); stable materials can turn combustible

(aluminium); insoluble materials may become soluble (gold). A material such as gold, which is chemically inert at normal scales, can serve as a potent chemical catalyst at nanoscale. Nanoscale materials such as nanopillars are sometimes used in solar cells which combats the cost of traditional Silicon solar cells. Development of applications incorporating semiconductor nanoparticles are to be used in the next generation of products. Such products include display technology, lighting, solar cells and biological imaging. Other applications are coating the surface of the wash hand basins and toilet bowls (minimizes surface tension thus reducing the possibility of particles adhering to the surface), preventing the steaming up of mirrors and tiles and preventing condensation droplets forming on their surfaces. On the surface of Active glass, grime is broken down by a daylight-activated reaction with a surface coating of titanium dioxide. The glass is also hydrophilic, which means that water spreads across it rather than forming droplets and thus can take the dirt with it. Rain effectively can thus clean the glass. Nanotechnology has led to developments in the science of photonics which is linked with opto-electronics and production facilities to make fibre-optic communication and switching devices. Cars are being manufactured with nanomaterials so they may need fewer metals and less fuel to operate in the future. There are however calls for stricter application of the precautionary principle, with delayed marketing approval, enhanced labelling and additional safety data development requirements in relation to certain forms of nanotechnology.

2.2 Building Information Modeling (BIM)

Building Information Modelling (BIM) is a set of interacting policies, processes and technologies generating a “methodology to manage the essential building design and project data in digital format throughout the building's life-cycle” (Penttilä, 2006). It is made of intelligent building components which include data attributes and parametric rules for each object. For instance, a door of certain material and dimension is parametrically related and hosted by a wall. Furthermore, BIM provides consistent and coordinated views and representations of the digital model including reliable data for each view. This saves a lot of designer's time since each view is coordinated through the built-in intelligence of the model. BIM is the process and practice of virtual design and construction throughout its lifecycle. It is a platform to share knowledge and communicate between project participants. High quality 3D renderings of a building can be generated from Building Information Models.

A collaborative BIM approach enables the sharing of the model between the engineer, architect, construction manager, and subcontractors. At the BIM meetings, the construction manager and subcontractor can provide their expert construction knowledge to the design team. Moreover, the construction manager can use the building information models to generate constructability reports, coordinate, plan, schedule and cost estimate. Traditional Design-Bid-Build, Design & Build and Integrated Project Delivery (IPD) methods are popular project delivery approaches that the industry currently practices. Construction managers can use BIM to extract quantities of work to prepare cost estimates. Construction managers can use BIM to coordinate work with subcontractors. They can also update schedule and costs with BIM. Lastly, they can turn over an as-built building information model to the owner's maintenance team.

2.3 Lean Construction

Lean construction is concerned with the alignment and holistic pursuit of concurrent and continuous improvements in all dimensions of the built and natural environment: design, construction, activation, maintenance, salvaging, and recycling (Abdelhamid et al., 2008). This approach tries to manage and improve construction processes with minimum cost and maximum value by considering customer needs (Koskela et al., 2002). The term "Lean Construction" was coined by the International Group for Lean Construction in its first meeting

in 1993 (Gleeson et al., 2007). It accomplishes these objectives through the use of Supply Chain Management (SCM) and Just-In-Time (JIT) techniques as well as the open sharing of information between all the parties involved in the production process. Womack and Jones (1996) identified the key principles for lean construction systems as value; value stream (by mapping the whole value stream, establishing cooperation between the participants, and identifying and eliminating waste, the construction process can be improved); flow (business flow includes project information, job site flow involves the activities and the way they have to be done, while supply flow involves the materials used in a project); pull (the efforts of all participants stabilize pulls during the construction process); and perfection (work instructions and procedures are developed, quality control mechanisms are established).

Four main principles of Lean construction system are the minimal use of building materials; minimal cost for affordability; maximum quality of building; minimal wastage of building materials and energy. These principles are examined from the design stage and through the whole management process. Ballard and Howell (1994) designed the Last Planner System as one method for applying lean techniques to construction. It provides productive unit and workflow controls and facilitates quick response to correct for deviations from expected outcomes by using root cause analysis. Control is defined as causing events to conform to plan as opposed to the construction tradition of monitoring progress against schedule and budget projections.

2.4 Green Architecture

Green Architecture basically refers to environmentally friendly buildings with these characteristics: 1- Ventilation systems designed for efficient heating and cooling. 2- Energy-efficient lighting and appliances. 3- Water-saving plumbing fixtures. 4- Landscapes planned to maximize passive solar energy. 5- Minimal harm to the natural habitat. 6- Alternate power sources such as solar power or wind power. 7- Non-synthetic, non-toxic materials. 8- Responsibly-harvested woods and stone. 9- Adaptive reuse of older buildings. 10 - Use of recycled architectural salvage. 11- Efficient use of space. While most green buildings do not have all of these features, the highest goal of green architecture is to be fully sustainable. Green Architecture is also Known As: Sustainable development, eco-design, eco-friendly architecture, earth-friendly architecture, environmental architecture, natural architecture.

Green building (also known as green construction or sustainable building) is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: design, construction, operation, maintenance, renovation, and demolition. Criteria for sustainable buildings are as follows 1- Natural light (level of natural light enhancement) - does the building enhance quality natural light for comfort and power efficiency? 2- Environmental impact (level of "greenness") - how environmentally friendly is the building on the eco-system? 3- Architectural design (level of flexibility and versatility) - how innovative is the architectural design of the building? 4- Thermal comfort (level of resistance to heat load) - how resistant is the building to heat load? 5- Water cycle (enhancement of water cycle) - does the building enhance reuse of water? 6- Appropriate technology (level of efficient usage and availability) - can the building be built using appropriate technology which is readily available locally? 7- Waste management (cradle to cradle concept) - does the building generate waste over the years that can be recycled and re-used? 8- Feedback (level of affordability and cultural acceptability) - do people generally like the building? 9- Air quality (level of impact on human health with proper ventilation) - how toxic is the building to living creatures? 10- Durability (level of resistance to climate and usage) - is the building resistant to corrosion, wear and tear, warping, fading, leaking and tropical ocean-salty climate?

3 Integrated Project Delivery

Integrated Project Delivery (IPD) is a collaborative alliance of people, systems, business structures and practices into a process that harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction. There are eight main sequential phases to the integrated project delivery method: conceptualization (expanded programming); criteria design (expanded schematic design); detailed design (expanded design development); implementation documents (construction documents); agency review; buyout phase; construction; and closeout phases. Facilities management is the final part. IPD contractually requires designers, construction manager, subcontractors and owners to share the project risks. If the project stays within budget, then all the project participants receive their share of the profits. Otherwise, they all lose their fees. This incentive promotes all the participants to work together towards a common goal. They share all the Building Information Model data, share decision-making, and share responsibilities. This joint project management approach results in pure collaboration and no litigation. BIM facilitates IPD by uniting all professionals involved in the project. The new focus in IPD is the final value created for the owner, the finished building. Rather than each participant focusing exclusively on their part of construction without considering the implications on the whole process, the IPD method brings all participants together early with collaborative incentives to maximize value for the owner. (See Figure 4) This collaborative approach allows informed decision-making early in the project where the most value can be created. The close collaboration eliminates a great deal of waste in the design, and allows data sharing directly between the design and construction team eliminating a large barrier to increased productivity in construction. Research Methodology

Methodology involves a literature survey on Artificial Intelligence and BIM with primary and secondary data collection on Green Architecture in Lagos, Nigeria. The method of primary data collection involved site visits to four sites in order to identify the green building materials used (such as expandable polystyrene cement sandwich wall panel). Green building material is one of the main aspects of green architecture in use in Lagos. Prefab system of construction is one of the main aspects of Lean construction technique in use in Lagos.

4 Findings and Discussions

The study found that Lightweight concrete foam is used in expandable polystyrene (EPS) cement sandwich wall panel. Advantages are that EPS foam is an excellent energy efficient thermal insulation material; it is non-toxic, safe and contains no chlorofluorocarbons or hydro-fluorocarbons so as not to damage the ozone layer; EPS foam can be recycled in a number of ways; Minimal waste with pre-punched openings for electrical and plumbing; pre-cut and preassembled headers and jambs; sustainable material that does not rot, rust or decompose; it requires no maintenance; it is mold, insect and rodent resistant; doesn't support mold growth; excellent resistance to moisture absorption; good sound insulation and sound-absorbing functions; good seismic performance; space saving, thickness of 60mm-180mm; and cost effective.



Figure 3. Service duct being inserted on site as worker on the right hammers box and barrel into each other

Innovative use of PVC and concrete a prefabricated system of construction by Royal Sanderton at Yaba College of Technology site (see Figure 3) provides evidence that the use of concrete and PVC casing (box and barrel) is three times faster than the conventional use of sandcrete blocks; waste on site is eliminated, thus the system is environmentally friendly; there is no need for columns and painting thereby reducing cost when mass produced; the quality of finished work is higher than conventional use of sandcrete blocks facilitating neater mechanical and electrical installations; the thermal comfort is better than conventional construction; the durability of PVC ensures that there is no need for painting in future thus saving maintenance cost; the PVC used comes in various tasteful colours which enhance the use of natural light; the building materials used are non-toxic to human beings and animals thus having a positive environmental impact with reference to air quality; the building materials used can be recycled and used again; the building materials can be used with any architectural design thus enhancing flexibility and innovative designs; the building materials used can be utilized on site by trained local workforce using appropriate technology; and this system of prefabricated housing construction is gaining popularity among investors in housing estates in Lagos

5 Conclusion and Recommendations

This study examines Artificial intelligence, Nanotechnology, Lean Construction and Green Architecture in order to find out whether these forms of technology and building materials are interrelated and used in the delivery of Green Architecture Projects in Lagos. The study found that there is an interconnection between advanced technologies (AI with Nanotechnology) and sustainable building construction, and Green Architecture, and the use of Integrated Project Delivery and BIM to form sustainable intelligent buildings and smart cities (see figure 4). The study identified the green building materials (such as expandable polystyrene cement sandwich wall panel) as one of the main aspects of green architecture in use and that the main aspect of Lean construction technique in use in Lagos is the prefabricated system of construction. However, Artificial intelligence nor nanotechnology and BIM were used on the project sites studied.

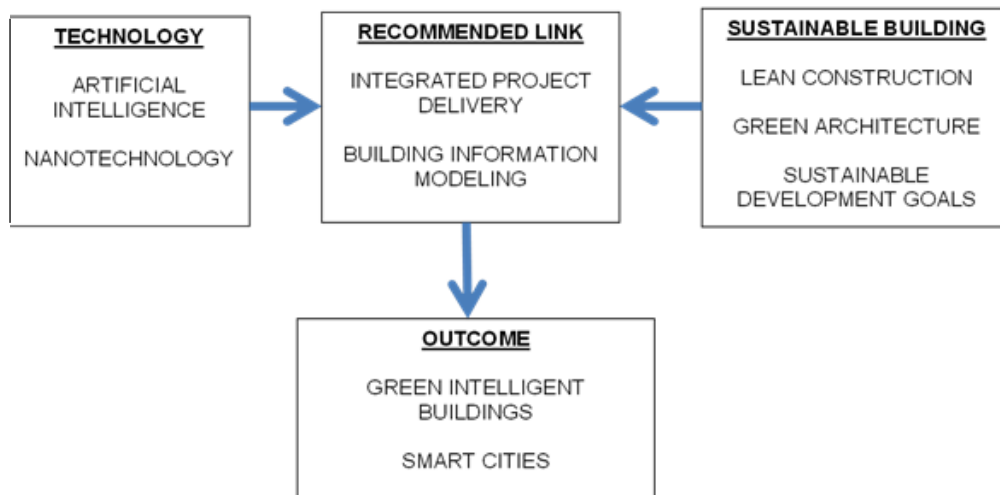


Figure 4. IPD and BIM bring together advanced technology with sustainable building to form smart cities

6 References

- Abdelhamid, T.S., El-Gafy, M., and Salem, O. (2008). "Lean Construction: Fundamentals and Principles." American Professional Constructor Journal.
- Ballard, G., and Howell, G. (1994). Implementing Lean Construction – Stabilizing work flow. "Conference on Lean Construction" at Santiago, Chile. September 1994
- Building automation - Wikipedia, the free encyclopedia, http://en.wikipedia.org/wiki/Building_automation (Accessed: 6 November 2013)
- Clements-Croome, D. 2004. Intelligent Buildings – Design, Management and Operations. ISBN: 0 7277 3266 8. Published by Thomas Telford books, London E14 4JD.
- Falconer, G. & Mitchell, S., 2012. Smart City Framework: A Systematic Process for Enabling Smart Connected Communities. /web/about/ac79/docs/ps/motm/Smart-City-Framework. (September).
- Gerhart, James., 1999, Home Automation and Wiring. McGraw Hill
- Gleeson, F. and Townend J. (2007). "Lean construction in the corporate world of the U.K. construction industry", University of Manchester, School of Mechanical, Aerospace, Civil and Construction Engineering.
- Hawking, S. (2014) Hawking warns on rise of the machines. Financial Times.com-Companies - Technology, December 2, 2014. <http://www.ft.com/intl/cms/s/>
- Koskela, L.; Howell, G.; Ballard, G.; Tommelein, I. (2002). "Foundations of Lean Construction". In Best, Rick; de Valence, Gerard. Design and Construction: Building in Value. Oxford, UK: Butterworth-Heinemann, Elsevier. ISBN 0750651490.
- Maranville, S (1992), Entrepreneurship in the Business Curriculum, Journal of Education for Business, Vol. 68 No. 1, pp.27-31
- Penttilä (2006) Describing the changes in architectural information technology to understand design complexity and free-form architectural expression ITCON 11 (Special Issue The Effects of CAD on Building Form and Design Quality) (2006), pp. 395–408
- Traugott, A. 1999. Green Building design equals high performance building design. Consulting specifying engineer. January. 68 – 74
- United States Green Building council (2016). Buildings and Climate Change. www.eesi.org/files/climate.pdf. Assessed on 11th January, 2016.
- Wikipedia. 2013. Building Automation Systems. Accessed 6th Nov 2013
- Womack, J. P, Jones, D. T. (1996). Lean Thinking: Banish Waste and Create Wealth in your Corporation. New York: Simon & Schuster.

CATEGORIZATION OF THE DUTIES AND REQUIRED COMPETENCIES OF A MANAGEMENT CONTRACTOR

Ayegba, Calistus; Laryea, Samuel

School of Construction Economics and Management, University of Witwatersrand, Johannesburg, Gauteng, South Africa

Abstract

Although, the traditional procurement system is more understood and more popular in usage when compared to other construction procurement systems, evidence from previous studies has reveals that management contracting procurement system is most suitable for large and complex projects, when projects are required to be delivered on time and when flexibility is desired during construction. It can be argued that the reported benefits of the management contracting system may as a result of the roles and duties performed by the management contractor. However, limited attention has been given to these duties performed by the management contractor which has resulted in the reported benefits of the system and also the required competencies for a management contractor to performing these duties. The aim of the study was to create a better understanding on the duties of a management contractor and the required competencies for a management contractor to perform these duties. Using documentary analysis and semi-structure interviews, data for this study will be collected from key roles players of management contracts in South Africa. The contribution of this study will help construction clients and the construction industry in the recruitment, selection, performance management and evaluation of management contractors. And, also add to the knowledge base for continuous professional development and training for aspiring management contractors. In addition, this study is also being used in establishing a scope for an ongoing PhD research.

Keywords: Construction procurement, Duties of a management contractor, Management contracting, Required competencies for a management contractor

1 Introduction

In recent years, the increasing needs for integration of project team, improved collaboration, risk sharing, early contractor's involvement and more relational relationship in construction project delivery system, project sizes and complexities as well as the need for enhancing the achievement of project outcomes of time, cost and quality, together has contributed to the development and adoption of other procurement system from the most common traditional procurement system. As indicated in the study by Al-Harhi et al. (2014), the shift from the traditional system has resulted in several changes to the organization, roles and systems adopted for development schemes. And, in conformity, management contracting procurement system has continued to gain more adoption by construction clients for their construction project delivery. The Chartered Institute of Building (CIOB, 2010) survey report on procurement in the construction industry indicated that as construction projects increases in complexity and value, the management contracting system tends to be the preferred choice of construction procurement adopted by construction clients. As well, in a Survey on construction

industry indicators by the Construction Industry Development Board (CIDB, 2014: 17) management contracting system was indicated to be the second mostly used procurement system by national and provincial departments together after the traditional system.

The management contracting system has been adjudged to be most suitable for large and complex projects, and when projects are required to be delivered on time and flexibility of construction is desired. In a study evaluating management contracting and investigating the significant difference in clients perspective of performance criteria between management and traditional procurement systems by Sidwell (1983) and Naoum (1994) respectively; the benefits in management contracting system were attributed to the improved integration of project team members, flexibility of the system, breaking down of work into packages with total competition of work packages, improved collaboration, risk sharing, early contractor's involvement and more relational relationship enhanced by the management contractor.

The distinguishing feature in the management contracting system from the traditional system is the introduction of a management contractor at an early stage of the project. According to Murdoch and Huges (2008: 59), the introduction of the management contractor allow for the contribution of the management contractor's experience and expertise in the design and construction management of projects. Therefore, it may be argued that the reported benefits of the system are as a result of the roles and duties performed by the management contractor. While research continuous to emphasize on the benefits and suitability of using the system (see Naoum, 1994; Naoum and Langford, 1987; Sidwell, 1983; Ward et al., 1991). However, limited attention has been given to the duties performed by the management contractor which has resulted in the reported benefits of the system and the required competencies by the management contractor in performing these duties.

The focus of this research therefore is to analyze the duties performed by management contractors and investigate the required competencies for management contractors to perform their duties effectively, when a construction client decides to entrust the management of construction project to a management contractor (Indicating the choice of a management contracting procurement system).

2 Management Contracting Procurement System

Management contracting is an established procurement system in the construction industry which is said to evolved from the United Kingdom (UK) (Sidwell, 1983). According to Murdoch and Huges (2008) the system has been in use for considerable time even though it is only in 1987 there has been a standard form of contract for it. The horizon factory in Nottingham for John payer limited designed by Arup and Associates and built by Bovis limited, as well as the British library in London where among the earliest projects built using this system (Murdoch and Hughes, 2008; Sidwell, 1983).

The international standard organization (ISO 10845-1 2010) describes a management contracting system as a contract in which a contractor provides consultation during the design stage and is responsible for planning and managing all post contract activities and for the performance of the whole contract. Several studies have described the system as consisting of 100% sub-contracting since every item of the work is subcontracted to the works contractors (see Al-Harathi et al., 2014b; Murdoch and Hughes, 2008; Naoum, 1994; Sidwell, 1983; Ward et al., 1991). However, in the guidance on procurement and contract strategies provided by the Institute of Civil Engineers (ICE, 2005: 7) management contractors may also participate in actual construction of some of the construction works. Whatever the case however, there is a consensus report that only the management contractor goes into construction work contract with the client for the entire works, and then takes responsibility for the administrative and

operational works of the contract, as against the case in a construction management system or a traditional system, where work contractors also goes into direct contract with clients.

2.1 *Difference between Management Contracting and the Traditional Procurement System*

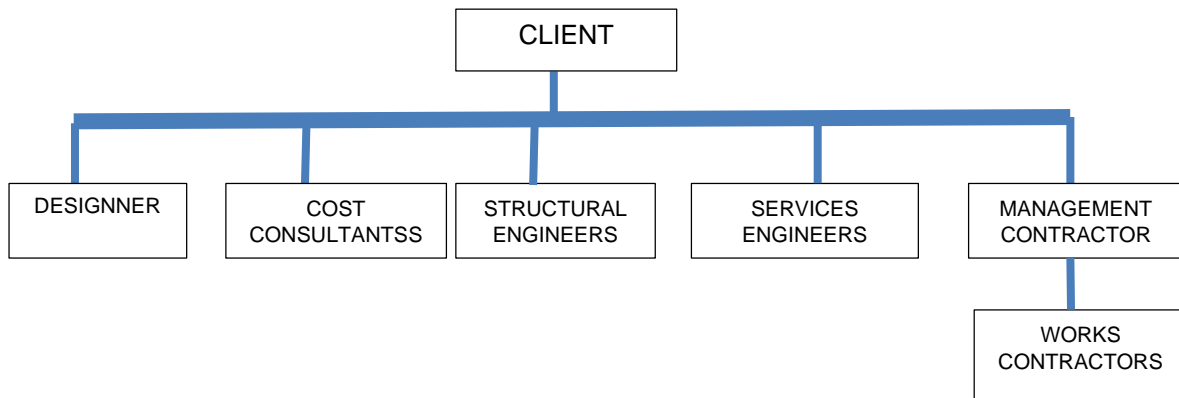


Figure 1. The management contracting system

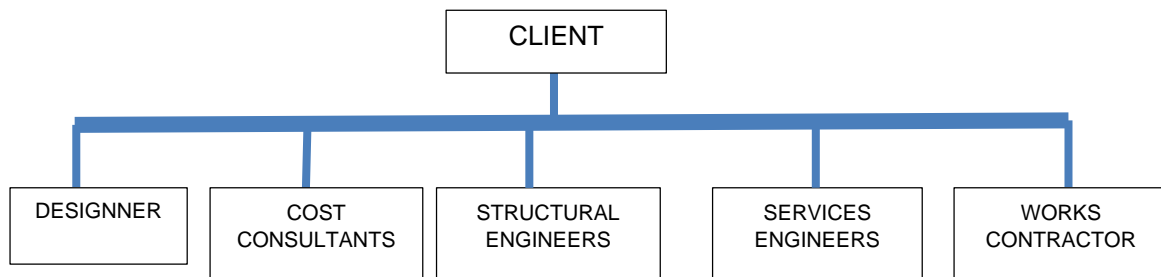


Figure 2. The traditional system

On review of organization structure and contractual relationships of management contracting and the traditional system of procurement as provided by (Al-Harthy et al., 2014b; Murdoch and Hughes, 2008; Naoum, 1994; Naoum and Langford, 1987; RICS, 2013; Sidwell, 1983; Ward et al., 1991), Figure 1 and 2 was developed to illustrates the contractual relationship and organization structure in expressing the differences of a management contracting and traditional procurement system respectively.

As indicated in the figure 1; considering the management contractor and work contractors, only the management contractor have a contractual relationship with the client and then appoints and manages the work contractors who are contractually accountable to the management contractor. In figure 2, the work contractor has direct contractual relationship with the client. this will result in a more active role by the client unlike in a case of management contracting where clients take a more detached role as suggested by (Naoum and Langford, 1987).

Also, the management contractor is indicated to be elevated to the same level as the consultants enabling him offer services both at the design stage and as well at construction stage. With this arrangement, the consultants will be having access to the expertise and experience of the management contractor at the design stage which may result in an improved consultancy services from the consultants. According to Murdoch and Hughes (2008) the opportunity provided for contractors to have the same status with the consultants is the major reasons why contractors favoured a management contracting system to the traditional system, where

contractors are directly placed under the scrutiny of consultants or the project principal agent, which usually are architect's depending on the type of project.

In addition, in management contracting, management contractors are engaged at the early in the project and facilitate the overlap of designs and construction being a member of the design team as well as the construction team as oppose to the traditional system in which there is separation of design and construction and designs are usually completed before construction commences. This has been attributed to the flexibility and early completion feature of a management contracting system(see Naoum, 1994; Sidwell, 1983 and Ward et al., 1991).

Furthermore, in management contracting system, sub-contracting is a major distinguishing feature. The management contractor does no construction works but rather subcontract all the works, which are usually broken down into work packages to the work contractors as submitted by (Al-Harathi et al., 2014b and Murdoch and Hughes, 2008). Contrary to the traditional system, where the work contractor is responsible for the actual construction of the construction work and may use subcontracting as well. However, according to ICE (2005:7) guidance on procurement and contract strategies, management contractors may also participate in actual construction work. Also, in management contracting, management contractors usually goes into a fee contract and are usually paid a prime cost of all works done plus the fee. Although, Murdoch and Hughes (2008) argued that certain direct works such as site staffing, provision of labour and materials and sundry cost services provided by the management contractor should be dealt with on a lump sum basis instead of cost reimbursement. But contractors in a traditional system are often paid a lump sum for the contract.

From the foregoing, these differences in management contracting from the traditional system appear to be responsible for the added advantages of that have been attributed to the system over the traditional procurement system. Thereby, making management contracting a more suitable procurement route particular for large and complex projects, and when early completion and flexibility during construction is desired.

2.2 Duties of a Management Contractor

In a case study involving 39 management contracts and 30 traditional contracts in UK, to investigate whether the means of procurement influenced project performance, Naoum (1994) reported that management contractor's liability and responsibility is not clear and there is not enough evidence to support how management contracting reduces overall building cost and quality of projects. This report may be an indication of a gap in knowledge on the duties performed by management contractors. However, Murdoch and Hughes (2008: 64) asserted that due to the duties performed by the management contractor, the roles of a contract administrator and a quantity surveyor may not be defined in a management contract.

Also, from the foregoing on the differences between management contracting and a traditional system, the benefits in management contracting could be attributed to the duties performed by the management contractor as a result of transition of responsibility of the management contractor in being a consultant as well as a contractor, providing services at the preconstruction stage and at the construction stage.

Owing to the different roles and responsibilities of the management contractor in a management contracting system, the duties performed by the management contractor can be argued to be clearly distinct from that of a general contractor in a traditional system. This calls for clarification of the duties of the management contractor and to categorize them accordingly in the different phases of a construction project.

Essentially, the duties performed by the management contractor maybe divided into pre-construction period duties and construction period duties as suggested by Murdoch and Hughes (2008: 64) with the management contractor carrying out duties such as professional team

integration, advising on breakdown of work packages and assisting with negotiations at the pre-construction stage; and duties such as programming and planning, monitoring off-site preparation work, instituting effective cost control techniques, labour relations and site management at the construction stage as well as providing site facilities and services. Sidwell (1983) in his study submits that the two most important duties of the management contractor may be in subcontractors control and design team integration. Similarly, Ward et al (1991) has reported coordination of work responsibilities and liabilities and control functions as the duties performed by a management contractor. These identified management contractor duties appears comparable to management duties as identified by Mintzberg (1973: 92) which includes interpersonal role of figurehead, leader and liaison; informational role of monitor, disseminator and spokesman; and decisional role of entrepreneur, disturbance handler, resource allocator and negotiator. Earlier view on managerial duties were described by Henry Fayol in 1916 (Fayol, 1954) to include Planning, organizing, controlling, commanding and coordinating.

2.3 Required Competencies of a Management Contractor

Competency has been described as the knowledge, skills, and behaviours required to performing well and keep up with the culture of an industry (Delo et al., 2010). Similarly, Mirabile (1997) earlier describes competency as the “knowledge, skill, ability or characteristic associated with high performance on a job, such as problems solving, analytical thinking, or leadership”. For a management contractor to perform required duties in management contracting effectively, it can be argued that there are required competencies the management contractors should possess. A number of studies have sought to identify required competencies and their relationship to positions and performance in different jobs.

Meredith and Mantel Jr (2011:142) in their book on “ Project management a managerial approach” categorizes project management required competences into six key skill areas, to include, communication, organization, team building, leadership, coping and technological skills. According to Delo et al (2010) recurring themes of competencies include behaviours such as self-control, resilience, communication, self-assurance, and those related to team leadership. Dainty et al (2005) suggest that Construction project managers have to combine technical knowledge and expertise with behaviours that engender effective multi-organisational teamwork and communication if successful outcomes are to be achieved. They further identified the competencies for project management performance to include the following: achievement orientation, initiative, information seeking, focus on client’s needs, impact and influence, directedness, teamwork and cooperation. Others are team leadership, analytical thinking, conceptual thinking, self-control and flexibility; with self-control and team leadership being the core competencies. In a report evaluating management contracting in the UK, builders management, construction, estimating, buying and planning are identified competencies made available to design teams by management contractors which brings the benefits of speed, economy and construction method (Sidwell, 1983).

Owing to the increased responsibility management contractors are expected to perform, undoubtedly the knowledge of their required competencies may provide clients with informed information for appropriately selecting a management contractor that will perform towards achieving expected project outcomes.

3 Research Methodology

The aim of the study was to contribute to the body of knowledge for a better understanding of the duties of a management contractor in a management contracting procurement system and the required competencies for a management contractor to perform these duties. This will require a comprehensive and inductive study of management contracts.

In view of this, the study adopted the descriptive survey method, involving the use of qualitative study via semi structure interview and documentary analysis of projects wherein management contracting was adopted. According to the CIDB (2014:17) report on construction industry indicators in South Africa, management contracting system was adopted for 34 projects across all employers category with the National and Provincial department being the main employer. Negotiation is ongoing to identify these projects for the purpose of case studies and to obtain relevant data from the key role players involved in such contract as part of an ongoing PhD research in management contracting. However, for this study due to time constraint, 3 recent cases of management contracts have been identified; upon which documentary analysis and semi structure interview with key role player was carried out.

4 Findings and Discussion

The data collection involved an examination of project tender documents and semi structure interview with key role player of three case studies of management contracting contracts.

From the examination of the project documents for the three case studies, the specific duties performed by the management contractor are presented in Table 1.

Table 1. Duties of Management Contractor

Duties	Description	Case study 1	Case study 2	Case study 3
Manage	Manage the procurement process, the implementation of project programmes, perform duties relating to overall management of contract, site administration and provide progress reports,	✓	✓	✓
Co-ordinate	Co-ordinate a considerable number of subcontractors, service providers and suppliers and supervises the work of the subcontractors	✓	✓	✓
Plan	Planning at a package level including development of maintenance plan and condition assessment and preparing forecast to define cost of work at intervals			✓
Direct	Direct the project team	✓	✓	✓
Design	Oversee development of design			✓
Facilitate	Early start of work to meet deadlines	✓	✓	✓
Procure Resources	Procure resources that are necessary to provide the required works and related professional design and condition assessment services			✓
Execute limited portion of the work	Execute limited portion of the work with own workforce, site establishment and de-establishment and provision of site facilities such as latrines, water and electrical services	✓	✓	✓
Contracting	Contracting, pricing and targeting strategy, and procurement procedure for the portfolio of projects administer package on behalf of the client, handover completed works and close out of projects and packages	✓	✓	✓

In addition, the findings from the semi- structure interview, from responses to the question on duties performed by the management contractor and required competencies to perform these duties are summarized as follows:

Duties

- The management contractor puts all service together like a turnkey development where everybody reports to the management contractor who integrates all everyone.

- The management contractor update scope and concept to construction drawings and the pre-construction stage
- Contribute in ironing out design issues, reviewing drawings, constructability issues and issues on how to get stuff delivered.
- Active partners as part of the development and planning of design team and up to delivery
- The management contractor manage and control subcontractors and other occupations and big size labour force during the construction process
- Carry out induction, safety and access arrangement
- Programming of works, getting people on time
- Ensuring site safety, managing the whole occupational safety, ensuring work is being secured on time in a safe and timely manner and save working environment
- Provides training, induction and ensuring everyone has tools and equipment to work with
- Motivate people: keeping people up motivated
- Managing clients in controlling changes to scope as it affects cost and deadlines

Competencies

- Sound knowledge of construction and building techniques and construction methodology such that will enable achieving same outcome but in a better way and cheaper cost. If something is not working the management contractor should be able to come up with a solution.
- Construction methodology: knowledge of what is new in the market, what is best in the market, the ability to take a drawing and say something is missing or that doesn't tie properly, there is need for more information. Ability to interpret designs, schedule and manage work flows
- Leadership qualities
- Knowledge of construction business
- Analyzing skills: be able to analyze projects and say this is the sequence of events, this is how I can afford these things, these are the different activities step and resources I will need.
- Construction management: Site administration, procuring subcontractors and then managing and coordinating their work quality and productivity. Being proactive solution driven on getting the job done as a team.
- Contract management: there will be a lot of contract relationship with suppliers, subcontractors which need to be managed.
- Conflict resolution: things are going to go wrong on site, you have to have the ability to manage them and go forward.
- Relationship formation : providing a link and relationship among the professional team
- Financial management: you need to manage cash flow so that you don't run out of cash by proper forward projecting

5 Discussion of findings

The aim of the study was to create a better understanding on the duties of a management contractor and the required competencies for a management contractor to perform these duties.

Duties refer to roles, responsibility or functions that management contractor has to perform. And competencies, according to Delo et al. (2010) has been described as the knowledge, skills, and behaviour required to perform well and keep up with the culture of an industry.

From the tender document analysis (table 2.) and summary of the semi-structure interview the duties performed by the management contractor can be seen to be multitasking covering both the preconstruction and construction stage of construction projects, as against what is obtainable in a traditional procurement system where the contractors only perform duties at the construction stage. These duties can be categorized into:

Construction management duties: here the management contractor performs management functions which Henry Fayol in 1916 (Fayol, 1954) describes to include Planning, organizing, controlling, commanding and coordinating. The management contractor is responsible for the overall management of the contract by putting and integrating all services together, he consult with and coordinates the professional team at the preconstruction stage and the work contractors at the construction stage. Management contractor carries out planning, organize, scheduling and programming of designs, work packages and site administration. Other construction management duties performed by management contractor are supervision, monitoring and quality control duties, to ensure that works are being constructed correctly. He also carries out reporting and provision of required project information and facilitates early completion of projects. Management contractors may also

Leadership duties: The management contractor plays an interpersonal role of figurehead. He directs the project team and work contractors as well as keeps people motivated in the course of executing the project. He also acts as the liaison; spoke person and resource allocator of the project.

Cost Control duties: here management contractors provides cost information to client and design team, prepares forecast to define cost of work at intervals, carry out cost estimation of work packages, manages clients and the design team in controlling changes to scope as it affects cost and formulate the most cost effective plan that will deliver the project within budget.

Buildability assessment duties: buildability assessment duties were adjudged as one of the core duties performed by the management contractor (Murdoch and Hughes, 2008; Sidwell, 1983). The management contractor becomes an active partner of the design team and uses his experience and expertise in construction to contribute in ironing out design issues, reviewing drawings and designs alternatives, construction feasibility issues, availability of labour, materials, plants and equipment, and issues on how to get stuff delivered. He updates scope and concept of the construction drawings, provides information on cost and materials, construction methodology, what is new and best in the market, and implications of various decisions in the course of the project.

Purchasing duties: here the management contractor purchases and order materials, supplies and resources that is necessary to provide the required works.

Contracting duties: the management contractor is responsible for evaluating, selecting, negotiating and going into contract relationship with a number of subcontractors, suppliers and other service providers in the client's interest. He is also responsible for the establishment and de-establishment of site at completion of project.

Conflict resolution duties: A management contractor manages disputes that may arise on site, and drafts and negotiates contracts properly to avoid ambiguities and dispute.

Relationship formation duties: Management contractors provide and facilitate links and relationship among project team as well as cooperate and seek cooperation with all persons involved in the project.

Health and Safety duties: here management contractors carry out duties ensuring site safety, manages the whole occupational safety and ensuring work is being secured on time in a safe manner and in a safe working environment. Also they have to ensure compliance to health and safety codes and regulations.

5.1 Required Competencies

According to Delo et al (2010), competency is the knowledge, skills, and behavior required to perform well and keep up with the culture of an industry. Owing to the increased responsibility of a management contractor in a management contracting procurement system as indicated in the duties of a management contractor from the foregoing, the competencies required to perform as a management contractor may be argued to be discern from that required to perform as a general contractor in traditional procurement system. The typical competency required for management contractors to perform their duties identified in the study includes the following:

1. Sound knowledge of construction techniques
2. Sound knowledge of construction methodology
3. Leadership skills including good temperament and self-control
4. Knowledge of construction business
5. Construction management skills including programming, planning, organizing, coordinating, supervising and monitoring skills
6. Analyzing skills
7. Financial management skills
8. Sound knowledge of contract management including knowledge of bid evaluation, negotiating power
9. Relationship formation skills
10. Conflict resolution skills

6 Conclusions

Management contracting procurement system is an option in construction procurement in which a management contractor is engaged at the early stage of a project, to contribute his experience and expertise in the management and delivery of the project. The system has been adjudged to have exhibited several benefits over the other procurement option particularly the traditional system. As a result, has been suggested to be most appropriate for large and complex projects, when timely completion and flexibility of construction is desired. These benefits may be attributed to the duties performed by the management contractors.

The knowledge of these duties and required competencies to perform management contracting duties by management contractors will help construction clients and the construction industry in the recruitment, selection, performance management and evaluation of management contractors. And, also add to the knowledge base for continuous professional development and training for aspiring management contractors. This study is also being used in establishing a scope for an ongoing PhD research on developing a decision support model for selecting a management contractor.

7 References

- Al-Harhi, A., Soetanto, R., Edum-Fotwe, F.T. (2014). Revisiting client roles and capabilities in construction procurement.
- Chartered Institute of Building (2010). A report exploring procurement in the construction Industry, Ascot: CIOB, Available at: <http://www.ciob.org/procurement>
- Construction Industry Development board (2014). Construction Industry Indicators. Available

- at <http://cidb.org.za/publications/Pages/Construction-Industry-Indicators.aspx> (accessed 9.19.15).
- Dainty, A.R., Cheng, M.-I., Moore, D.R. (2005). Competency-based model for predicting construction project managers' performance. *J. Manag. Eng.*
- Delo, A., Hepworth, P., Hepworth, A. (2010). Assessing the competent project manager. *Proj. Manag. Today* 1–6.
- Fayol, H. (1954). *General and industrial management*.
- Institution of Civil Engineers (2005). *NEC3 Procurement and contract strategies*, ISBN: 0727733818
- ISO 10845, 1, (2010). *ISO 10845-1:2010 - Construction procurement -- Part 1: Processes, methods and procedures*. http://www.iso.org/iso/catalogue_detail?csnumber=46190 (accessed 9.18.15).
- Meredith, J.R., Mantel Jr, S.J. (2011). *Project management: a managerial approach*. John Wiley & Sons.
- Mintzberg, H. (1973). The nature of managerial work.
- Mirabile, R.J. (1997). Everything You Wanted to Know about Competency Modeling. *Training Developmet*, 51, 73–77.
- Murdoch, J.R., Hughes, W. (2008). *Construction contracts: law and management*, 4th ed. ed. Taylor & Francis, London ; New York.
- Naoum, S.G. (1994). Critical analysis of time and cost of management and traditional contracts. *Journal of Construction Engineering and Management*, 120, 687–705.
- Naoum, S.G., Langford, D. (1987). Management contracting-the client's view. *Journal of Construction Engineering and Management*, 113, 369–384.
- Sidwell, A., 1983. An evaluation of management contracting. *Construction Management and Economics*, 1, 47–55.
- Ward, S.C., Curtis, B., Chapman, C.B., 1991. Advantages of management contracting-critical analysis. *Journal of Construction Engineering and Management*, 117, 195–211.

FORMULATING AN EFFECTIVE PUBLIC PRIVATE PARTNERSHIP POLICY FOR HOUSING PROVISION IN NIGERIA URBAN CENTRES: A CONCEPTUAL APPROACH

Gbadegesin, Job Taiwo; Harry van der Heijden; Boelhouwer, Peter
OTB, Research Institute for the Built Environment, Delft University of Technology, Delft, The Netherlands

Oladokun, Sunday Olarinre

Department of Estate Management, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract

The argument in the recent time was that the past strategies of the government in housing provision were obviously in favour of high income groups as the low-medium groups are victims of housing inadequacy in cities. The corollary to the situation resulted to the call for the adoption of public private partnership (PPP) initiative in order to accomplish the broad goal of housing-for-all in Nigeria. Most recent studies have established that there is no substantial contribution reported from the initiative, as the housing outputs are only affordable at present by high income groups, thus there is a need for a policy framework to ensure an effective PPP in urban housing provision. The aim of this paper is to suggest a policy framework for the way forward- the approach that is based on both theoretical and conceptual model, as related to Nigeria housing provision structure. This study utilises existing empirical studies, reports and theoretical concepts. *It also utilises the responses from housing professionals on modalities of enhancing urban housing provision through PPP model in Nigeria.* It was confirmed that the PPP model for housing provision in Nigeria is an emerging concept that lacks a specific policy and has little contribution in urban housing provision. Hence, the paper opines that the context for ensuring an effective collaboration that will make a PPP model is by incorporating all the institutions (poles), interests (motivating factors), norms, values (cultural practices), property rights and transaction costs. It is concluded that all the income groups should be considered as parts of the stakeholders in the formulation of a better PPP policy framework that addresses the housing needs of the majority of the dwellers in cities. This conceptual idea is referred to as New Institutional Economics (NIE) Approach.

Keywords: Housing, Institution, Nigeria, PPP, Urban Centres

1 Introduction

Housing is a fundamental need that currently constitutes a significant problem for the urban low income class especially in Sub-Sahara Africa (SSA). Although, an issue of inadequate housing provision is universal, the dimension of deficit in the urban centers in the developing Africa countries is becoming unbearable (Tipple, 1994). For instance, Olotuah and Bobadoye (2009) revealed that Nigeria housing shortage has reached an alarming state that almost 75% of the urban dwellers live in slums and in conditions that are degrading to human dignity. Between 1991 and 2001, housing deficit was estimated at about 8 millions (Achunine 1993; UN-HABITAT, 2001). In 2006, Nigeria housing deficit was estimated around 16 million units

and required more than N56 trillion to bridge the housing deficit at a conservation cost of N3.5 million per unit (World Bank, 2013).

In the recent time, Government of the Federal Republic of Nigeria recognized the impact of private providers and inaugurated a concept referred to as enabling framework. This is a PPP framework that government serves as the enabler and private developers as the providers. Good examples are the Abuja Mass Housing Provision and other outputs across the nation. Though housing is not expressly stated as part of the infrastructure in the PPP legal instrument in Nigeria, but it is impliedly opined that housing constitutes part of the infrastructure in urban centres. Infrastructure procurement through PPP in Nigeria is legally backed up with Infrastructure Concession Regulatory Commission (Establishment, etc) Act of 2005 and subsequent establishment of Infrastructure Concession Regulatory Commission. The original intention of private integration into housing provision in Nigeria was to address the huge urban housing shortage. However, *despite the acclaimed PPP model (enabling framework) and the promising notions of housing for all, why is it that most of the outputs by the providers are out of reach of the low income groups? How can an effective policy measures be formulated to make a functional PPP structure for urban housing provision in Nigeria?*

In order to address this question, this paper is structured into six sections. In section 1.0, an introductory background is provided. Section 2.0 describes the methodology of this work. Subsequent sections provide a review on housing situation and vulnerability in Nigeria, national housing policy (NHP) and the idea of PPP for housing provision in Nigeria: The inputs and findings. In the penultimate section, the policy way forward as the central and unique purpose of this paper is provided. This study is concluded on the summary of findings and recommendations.

2 Methodological Approach

This study adopted a review of existing empirical and non - empirical studies, position papers, theoretical concepts and documents on PPP model for housing provision in Nigeria. It also utilised the responses from housing experts on modalities to enhance housing provision in cities through PPP model in Nigeria. In the review, the contribution and the challenges of PPP are examined in Nigeria. Considering the state of the art in housing provision, this article advanced to suggest a bottom-up and pragmatic approach referred to as New Institutional Economics which takes into consideration the incorporation of both formal and informal institutions in PPP policy formulation in order to ensure an effective policy for PPP adoption in Nigeria.

3 Housing Situation and Vulnerability in Nigeria

Nigeria experience of socio – demographic and political changes could be argued as the root cause of the challenging housing situation in cities. The high rate of population and urbanization in Nigeria is not left out among the influencing factors that cause overcrowding and inadequate resources. World Bank (2013) reports that almost 55 % of total population growth in Nigeria account for urban population, as a result of people’s quest to achieve better lives in cities. This is also a clear evidence of income disparity, widening the gap between the rich and the poor in Nigeria (Centre for Affordable Housing Finance in Africa, CAHF, 2014) per capital income in Nigeria is low and this influences the purchasing power of the urban dwellers on housing acquisitions (Tipple, 1994; UN-HABITAT, 2010). These confirm the opinions of several authors that in the developing countries (World Bank Development, 2002; Department of International Development DFID, 2005; Kissick, Leibson, Kogul, Bachmann, Anderson and Eckert, 2006; Rashidi, Aukd and Mohammadian, 2012) and in the developed countries (Boelhouwer and Van der Heijden,1992; Haffner, Hoekstra, Oxley and Van der Heijden, 2009 and Boelhouwer & Priemus, 2012), housing provision exhibits interactive and

influential relationship with socio-economic, demographic, institutional and political environments.

In Nigeria, the state of the art on housing can be attributed to four main issues (Agunbiade, 1983, Ndubueze, 2009; Olotuah and Bobadoye, 2009; Oni, 2011; Ojo et. al., 2015) (Figure 1).

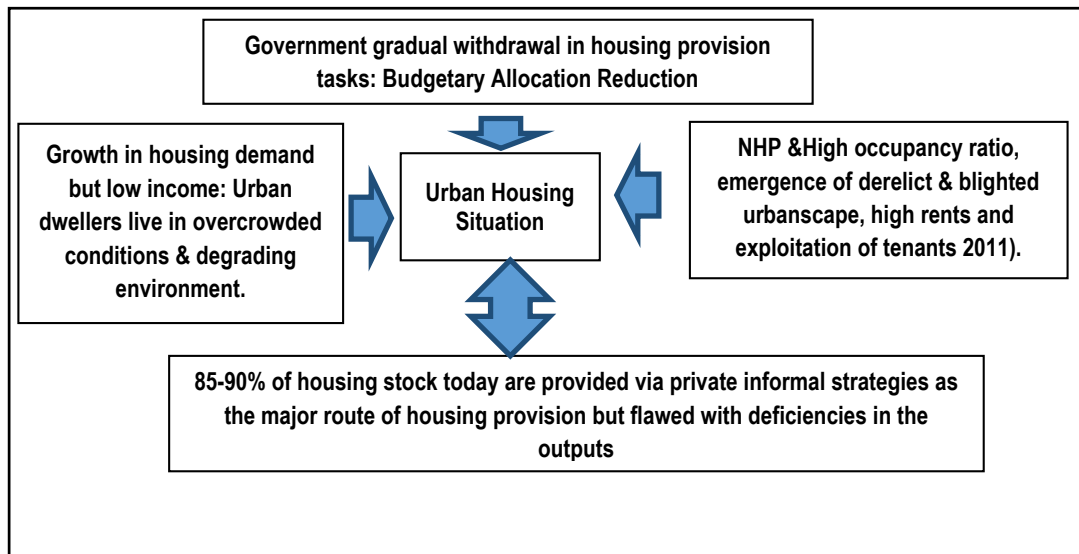


Figure 1. Description of urban housing situation in Nigeria (Authors, 2015)

In Figure 1, urban housing situation is described as the expression of the gradual withdrawal of government from housing provision, increase in housing demand and the existing housing policy that does not help to resolve the huge housing challenges. Consequent to the situations is the emergence of various strategies adopted by the private individual/ household to provide housing. This led to the emphasis that PPP could offer a possible solution in the country as mentioned in the national housing policy.

4 National Housing Policy and PPP for Housing in Nigeria: The Inputs and Findings

Housing - for - all has been the emphasis of NHP since 1991. In Nigeria, housing policy seemingly lies at the intersection of welfare and economic aspect of housing which realistically makes housing neither a universal service of the government nor the full free market output in Nigeria. It implies that these systemic attributes manifest in neo-liberal market ideology within the context of institutionalism (conventional and unconventional) that involves all actors in the sequences of events, property rights and transaction costs (Mooya and Cloete, 2007).

The encouragement of private involvement in housing delivery in Nigeria commenced in the year 2000, though in a more market oriented approach. In this approach government serves as the enabler and the organised private developers as the main providers. The initiative started from allocation of land and arrangement of finance with mortgage institutions: prominent among the initiatives is Abuja Mass Housing Scheme. The project was launched with an objective of providing adequate and affordable housing accommodation for the growing population within the territory. The procedure for allocation of large expanse of land for masses at low prices was incorporated with it. A study by Ukoje and Kanu (2014) identified that plots of land were allocated for the scheme in some districts in the federal capital territory (FCT), Abuja. According to Ukoje and Kanu (2014), lands were allotted for the schemes in different districts such as Dakwo, Wumba, Kafe, Karsana, Dutse, Bunkoro, Lokogoma, Galadimawa

and other locations. As stipulated in the in the Official Gazette No. 84, Vol.96 of 2009, it is required that the developers comply with the city’s regulations, standards and specifications during construction of the housing units (FRN, 2009).

In Lagos area, Ibem (2011a) examined that the least price of the housing produced was within the range of \$21,000-\$22,000¹. This is extremely high in the society where there is a high income disparity and low per capital income (Ibem and Aduwo, 2012) The pattern of PPP operation in Nigeria has no specific policy as it is purely based on memorandum of understanding (Ibem, 2011b). Again, in the study by Ibem (2011b), in six cities in Nigeria, it was found that the PPP approach has not made any significant contribution to housing low-income earners; rather it is skewed towards providing housing for high- and middle-income earners. According to Ibem (2011a, 2011b and 2012) , there is a need for a specific policy framework on PPP, proper land arrangement at low cost, reform inbuilding standard and incorporation of informal housing provision.. However, the foregoing studies failed to demonstrate conceptually the modalities for an effective PPP policy framework. This is the essence of this article.

Umoh (2012) revealed that the mass housing concept of federal government is a variant of PPP model designed with intention to provide housing in large- scale for low-medium income groups which constitutes 65% of the population. However, the realisation of the aim is constrained by numbers of barriers that can be described as transactional costs (Van Ommeren and Van Leuvensteijn, 2005; Van Ommeren, 2008; and Marinescu, 2012). Mode of transaction of housing units produced through PPP model today is characterised with unequal and uneven distribution across the income groups (Ndubueze, 2009). In the study conducted by Ibem (2011a), numbers of PPP housing units were identified that are far beyond the affordability limit of the majority of the cities dwellers. Table 1 provides the details.

Table 1. Some PPP contributions to housing projects in Nigeria

Housing schemes	Location	Partnership Agency	Units per target income group		
			Low	Middle	High
Lekki Apartment	Lagos MCR	LSPDC	-	-	126
OGD-Grant	Lagos MCR	GCDCL	-	60	100
OGD-Sparklight	Lagos MCR	GCDCL	150	250	-
Paradise City	Lagos MCR	GCDCL	-	100	200
Ewu Elepe Housing Estate	Lagos MCR	LSPDC	50	119	50
Ikeja GRA Housing Estate	Lagos MCR	LSPDC	-	-	36
Ilupeju	Lagos MCR	FHA	-	-	26
DN Meyer	Abeokuta	FHA	-	50	-
Trans Amadi	Port Harcourt	FHA	100	200	171
Trinity Gardens	Port Harcourt	RSHPCD	-	-	32
New Rainbow Town	Port Harcourt	RSHPCD	-	-	704
Ehimiri Housing Estate	Umuahia	ASHPCD	-	200	300
APICO- Shelter Afrique	Uyo	APICO	-	335	-
Total			300	1,314	1,745

(Source: Ibem, 2011a; 2011b)

¹1 Dollar = 199 Naira as at December, 2015.

Information in the Infrastructure Concession Regulatory Commission (ICRC) (2013) document, as reported by Dominic et al. (2015) indicated that private partnership with federal housing authority has also delivered some housing units across the country. Table 2 presents details of PPP housing projects recently documented.

Table 2. PPP housing projects - federal housing authority and private companies

S/N	Name of Partnership	Location	Output Units
1	FHA/CITEC International	Gwarinpa, Abuja	300
2	FHA/ADKAN Services	Gwarinpa, Abuja	351
3	FHA/BAUHAUS Int. Ltd	Isheri-Olofin, Lagos	554
4	FHA/BAUHAUS Int.Ltd	Trans-Amadi, PortHarcourt	288
5	FHA/PRINCE & PRINCESS Properties Limited	Lugbe, Abuja	70
6	FHA/ OHMS Limited	Gwarinpa, Abuja	20
7	FHA TANGENT	Irette, Owerri	140
8	FHA/Tangent Partnership	Irette, Owerri	201
9	FHA/ Bauhaus Partnership	Irette, Owerri	150
10	FHA/Zincspace Partnership	Lugbe, Abuja	54
11	FHA/Good Homes Ltd	Egan, Lagos	349
12	FHA/ENL Partnership	Apo, Abuja	923
13	FHA/ Bauhaus Partnership	Apo, Abuja	523

(Source: ICRC, 2013; Dominic et al., 2015)

It was also reported that PPP contractor – financed initiative programmes, sponsored by the federal ministry of land, housing and urban development (FMLHUD) have also delivered units of housing across some states in the federation. The then Minister of the ministry, Pepple (2012) presented the achievements in 2012 annual report. Table 3 shows the details.

Table 3. PPP contractor-financed initiative programmes

S/No	State	No of developers	Size of land (hectares)	No of houses realizable	Type of building technology	Completion period
1.	Adamawa	2	13	260	Traditional	20 months
2.	Cross river	18	250	5,000	advanced bamboo product/nibri bricks/traditional	“
3.	Delta	11	25	500	Plasswall/traditional	“
4.	Edo	5	184	3,680	Plasswall/insulated concrete forms/traditional	“
5.	Enugu	4	30	600	Nibri bricks/traditional	“
6.	Katsina	1	5	100	traditional	“
7.	Kogi	4	21.15	423	American building system/traditional	“
8.	Lagos	1	1.04	24	traditional	24 months
9.	Nassarawa	28	109	2,180	Hydraform/nibri bricks/western form tech/traditional	20 months
10.	Ogun	15	224	4,500	American building system/insulated concrete form/traditional	20 months
	Total	89	889.54 hectares	17,267		

(Source: Pepple, 2012; Federal Ministry of Land, Housing and Urban Development)

In a related study by Ojo, Olatoye-Ojo and Gbadegesin (2015), PPP is viewed as an avenue to bridge the finance gap in infrastructure provision. It was also explained from the perspective of PPP variants including Build-Operate-Transfer (BOT) as an antidote to address deficit (Gbadegesin, Aluko and Nuhu, 2012; Gbadegesin and Aluko, 2014; Gbadegesin and Oyewole, 2014). It is found that the practice, referred to as PPP are often investment-oriented rather than welfare oriented scheme in Nigeria (Ibem and Aduwo, 2012).

The implication is that in a partnership or collaboration arrangement, if transaction costs (requirements) hinder low class citizens from acquiring housing right in the model, the effectiveness is not guaranteed. Williamson (1985), North (1990) and Coase (2005) posit that transaction costs are key elements in any institutional arrangement which cannot be overlooked. This is because uncertainties in partnership could be resolved in the process of coordination to achieve the output (housing). This is true of the key concepts of New Institutional Economics (NIE) as examined by Mooya and Cloete (2007), Wakely (2014) and Karrina (2013).

5 The Policy Way Forward: Institutional Approach (New Institutional Economics – NIE)

The importance of New Institutional Economics (NIE) in the collaborative scheme for housing provision is that all stakeholders (housing provision actors) are integrated with the understanding of the cultures, norms, values, regulations, rights and costs (Pratiwi, 2005). According to the author, the approach would be of immense contribution in exploring the nature and circumstances in the course of the partnership in housing provision. *Identifying the inputs of all poles (institutions) that entail the interests, norms, regulations, challenges, financial status and cultural orientations are fundamental to form a workable partnership as embedded in NIE.* Table 4 provides the details of the housing studies that have adopted the NIE theoretical and conceptual approach to resolve urban policy issues in the developed nations.

Table 4. Summary of housing and properties studies that are based on Institutional Theory

Serial No	Authors	Year	Study Focus	Institutional Analytical Concepts Used or Recommended
1.	Morgan	2010	Residential property development in urban centre	Agency Model
2.	Healey and Barrett	1990	Urban development process with the involvement of key actors	Structure –Agency analytical approach
3.	Ball	1998	Commercial property research in Britain.	Structure-Agency and Structure of Building Provision
4.	Guy and Henneberry	2000	Urban property development	Systematic provision structure & Actor-Network Approach
5.	Healey	2006	Governance Transformation for new space	Actor- Networks
6.	van Bortel and Elsinga	2007	Social housing in The Netherlands	Network Perspective of Policy Environment Actors
7.	Knight and Boyd	2008	Property development and developers' action	Social and formal networking via semi-structured interview
8.	Zhang and Rasiah.	2015	Urban housing market	Structure–Agency Institutional (SAI) model and the Institutional Analysis and Development (IAD) via both qualitative and Quantitative Approaches
9.	Healey and Davoudi.	1993	Urban Development	Systemic and Agency based approaches
10.	Healey.	1994	Behaviour of agencies in urban policy and development	Analysis of agencies behaviour based on structure of provision in the system
11	Healey	2003	Collaborative planning for in development	process', the use of 'social theory', and 'power', and the development of 'institutionalist' analysis
12.	Adams, Leishman and Watkins.	2012	House builder networks and residential land markets	Actor-Network Approach
13.	Pratiwi.	2005	Urban Housing Problem	Institutional analytical framework modified or adapted to the subject system
14.	Tang	2006	Urban Housing	Market Structure and Players interaction
15.	Han and Wang	2003	Urban Development projects	A framework of institutional analysis
16	Doak & Karadimitriou.	2007	Property development process	Network analytical approach
17.	Triantafyllopoulos	2008	Property ownership and land market	Diachronic analysis
18.	Manzi and Jacobs.	2008	Urban housing involving both formal and informal	New institutionalism, Grid-Group and Actor-Network Approaches are suggested
19	Maginn, Thompson & Tonts	2008	Urban housing analysis	Systematic reviews, meta-ethnography (if applicable) and realist synthesis
20	Karruna	2013	Land and Housing Market	Case study analysis of both formal and informal settlements
21	Woolthuis, Hooimeijer, Bossink, Mulder and Brouwer	2013	Sustainable Urban Development in Dutch.	Analysis of interactive framework of both formal and informal sectors
22	Van der Krabben and Lambooy	1993	Functioning of Dutch property market	Institutional Organisational approach of real estate study

(Source: Authors, 2015)

Extant literature indicates institutional analysis as a pragmatic approach which would enable details of relationship in the negotiation of development under different conditions (Healey, 1991; Manzi and Jacobs, 2008; Maginn, Thompson and Tonts, 2008). The key concepts of the institutional approach are described in Figure 2.

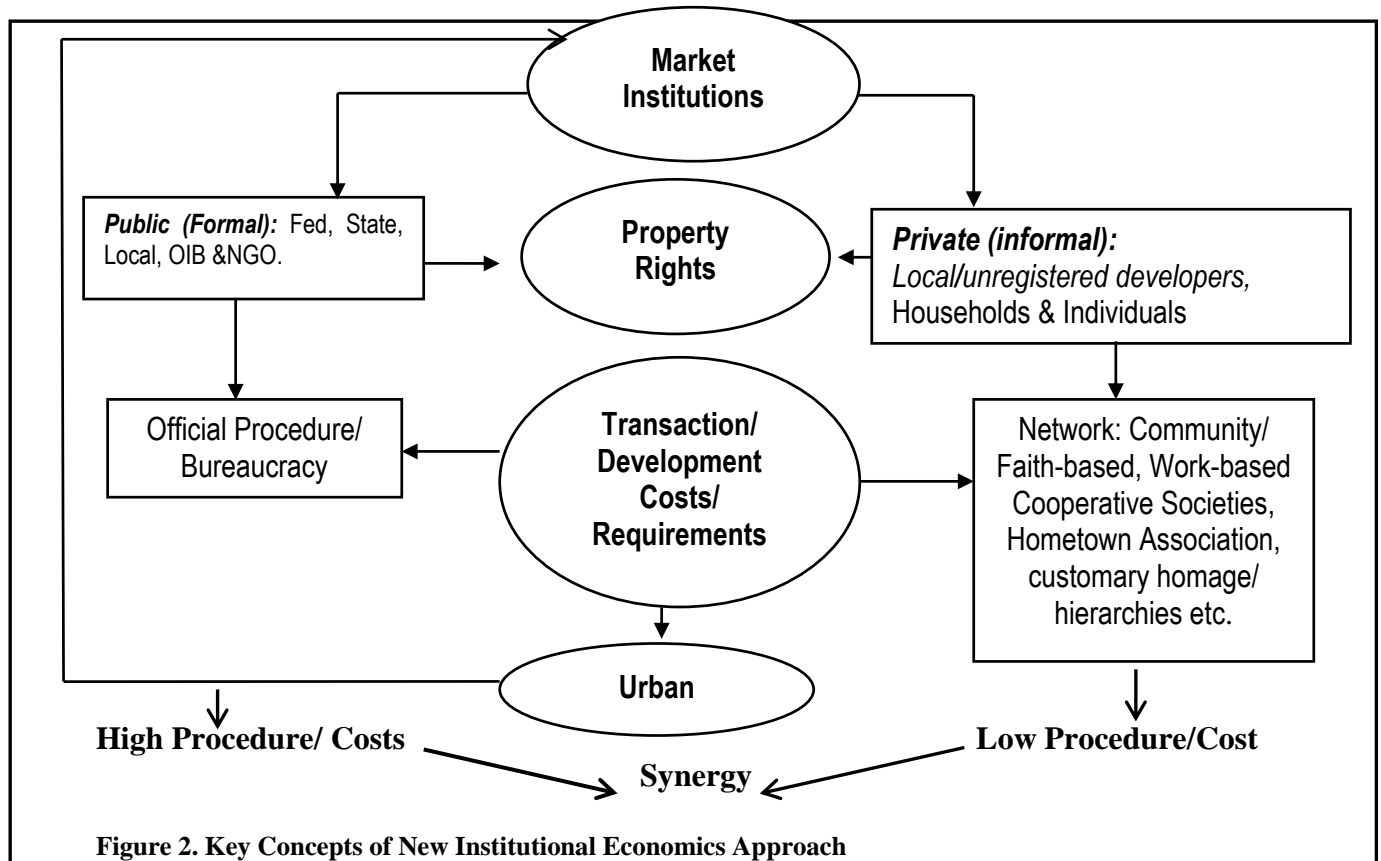


Figure 2. Key Concepts of New Institutional Economics Approach

The emphasis in Figure 2 is that, transaction costs are viewed in terms of processes, protocols, procedures, bureaucracy and financial requirements, agency costs (search and information), legal costs, costs of title procurement (property rights) (Karruma, 2013; Smith, Munro and Christie, 2006). Property rights are described as people’s access to land resources and the regulatory frameworks that enable both housing providers and consumers to harness interest (quantum of rights) and security in property (Whinston, 2003). Property rights and transactions are a key element of institutional approach in order to enhance housing market because if the rights (sufficient legal power and security such as rights to transfer- let/ lease, sale, acquire, mortgage, transfer or assign) are in place and enforceable, then transaction costs (requirements) would be reduced and therefore eliminate barriers to entry to the market properly (Karruna, 2013). The opinions of the housing experts solicited also revealed that PPP concept can only be functional in Nigeria if all the stakeholders’ needs, voices, conditions and aspirations can be evaluated and put into consideration.

6 Conclusion

In this paper, it has been noted that there is no effective and efficient PPP model for housing due to the lack of a specific policy to that effect, especially for low-income earners. The implication is that as the housing debacle in Nigeria remains the problem and the PPP conceptual objectives have not been significantly achieved, there is a need for a clear policy for collaborations that will consider all institutions (poles) rules, interest, norms, culture for

secured (reliable) housing rights at a less stringent costs (requirements) and boost the housing provision in cities. Therefore, to *avoid the future risks of neglecting low-medium income groups' interest and ideologies, a reform in policy approach of the PPP model is indispensable* through a collective approach that incorporates all groups.

7 References

- Achunine, B.O. (1993). National trends in housing production practices in Nigeria-, case Study prepared for UNCHS (Habitat), Nairobi.
- Adams, D. Leishman, C. and Watkins, C.(2012),Housebuilder Networks and Residential Land Markets. *Urban Studies*. 49(4) 705–720.
- Aluko, B.T. and Amidu, A.(2005). Corporate business valuation for mergers and acquisitions. *International Journal of Strategic Property Management*, 2005, 9(3), pp. 173-189
- Ball, M. (1998). Institutions in British Property Research: A Review. *Urban Studies*, 35(9), 1501- 1517.
- Berger, P. and Luckmann, T. (1967) *Social Construction of Reality*. New York: Anchor Books.
- Boelhouwer, P. and Priemus, H. (2012). Housing system reform: the opinion of advisory boards versus political reality in the Netherlands. Policy & Practice. *Journal of Housing and the Built Environ* DOI 10.1007/s10901-012-9288-3
- Boelhouwer, P. and Van der Heijden, H. (1992). Housing systems in Europe part 1: a comparative study of housing policy,” *Housing and Urban Policy Studies*, Delft University Press, Delft.
- Boelhouwer,P. and Hoekstra J.(2012): Agents and Regulators. In: Susan J. Smith, Marja Elsinga, Lorna Fox O’Mahony, OngSeowEng, Susan Wachter, Richard Ronald, editors. *International Encyclopedia of Housing and Home*, Vol 3.Oxford: Elsevier;pp.585-589
- Coase, R. (1998). The New Institutional Economics. *The American Economic Review*, 88 (2) 72-74.
- Coase, R.H. (2005). The institutional structure of production. In: Menard C. and Shirley M.M (eds) *Handbook of New Institutional Economics*. Berlin: Springer. pp. 31-39.
- Doak, J. and Karadimitriou, N. (2007). (Re)development, Complexity and Networks: A Framework for Research”. *Urban Studies*, 44(2), 209–229.
- Dominic, C. M.U., Ezeabasili, A., Okoro, B.U., Dim, N.U. and Chikezie, G.C.(2015). A Review of Public Private Partnership on some Development Projects in Nigeria. *International Journal of Application or Innovation in Engineering & Management*. Vol. 4. Iss. 3.
- DFID (2005). *Making Market Systems Work Better for the Poor (M4P) – An Introduction to the Concept*. Discussion Paper prepared for the ADB-DFID ‘learning event’, ADB Headquarters, Manila.
- FRN (2009). *Guidelines for Housing Development in the Federal Capital Territory (FCT)*, Abuja. FCTA, Abuja.
- Gbadegesin, J.T., Aluko, B.T. and Nuhu, M.B. (2012), Enhancing Students’ Housing through Build-Own-Transfer (BOT) Mechanism in Nigerian Tertiary Institutions. *The Estate Surveyor and Valuer. The Journal of Nigerian Institution of Estate Surveyors and Valuers*, Lagos. 36(2), pp.170-182.
- Gbadegesin, J.T and Aluko, B.T.(2014). Public Private Partnership/Private Finance Initiative for Financing Infrastructure in Public Tertiary Institutions in Nigeria. *Journal of Built Environment Projects and Asset Management*. 4(2).

- Gbadegesin, J.T. and Oyewole, M.O. (2014). Is Build-Operate-Transfer (BOT) system an effective initiative compared with traditional procurement method in student housing provision in an emerging economy? *Journal of Construction Project Management and Innovation*, 4 (1), 809-825, pp. 2223-7852.
- Guy, S. and Henneberry, J. (Eds.) (2002). *Development and Developers: Perspectives on Property*, Oxford: Blackwell Science.
- Haffner, M. Hoekstra, J., Oxley, M, Van der Heijden, H. (2009). Bridging the Gap between social and market rented housing in six European countries? *Housing and housing policy studies* 33. IOP Press.
- Han, S.S. and Wang, Y. (2003). The Institutional Structure of a Property Market in Inland China: Chongqing. *Urban Studies*, Vol. 40, No. 1, 91–112.
- Healey, P. (1994). Urban policy and property development: the institutional relations of real-estate development in an old industrial region. *Environment and Planning A*, 26, pp. 177-198
- Healey, P. (2003). Collaborative Planning in Perspective. *Planning Theory*. Vol 2(2): 101–123 .SAGE publications(London, Thousand Oaks, CA and New Delhi).[1473-0952(200307)2:2;101–123;035447].www.sagepublications.com
- Healey, P. (2007). An institutional model of the development process” *Journal of Property Research*, 9(1), pp. 33-44
- Healey, P. (1991). Models of the development process: a review. *Journal of Property Research* 8 219-238.
- Healey, P. & Barrett, S. M. (1990). Structure and Agency in Land and Property Development Processes: Some Ideas for Research. *Urban studies*, 27, 89-104.
- Healey and Davoudi (1993). The Development Industry in Tyne and Wear. Working Paper. No.21. Department of Town and Country Planning. University of Newcastle Upon Tyne, UK.
- Ibem, E.O. (2011a) 'Public-Private Partnership (PPP) in Housing Provision in Lagos Megacity Region, Nigeria. *International Journal of Housing Policy*, 11: 2, 133 — 154
- Ibem, E.O. (2011b). The Contribution of PPPs to improving accessibility of low-income earners to housing in southern Nigeria. *Journal of Housing and the Built Environment*. 26: 201-217.
- Ibem, E.O. and Aduwo, E.B.(2012) Public-Private Partnerships (PPPs) in Urban Housing in Nigeria: Evidence from Ogun State. *International Journal of Architecture and Urban Development*, 2(2), Spring 2012
- Karruma, R. (2013). Institutional Ignorance in an urbanising World: Does new institutional economics provide a useful tool for understanding the provision of land and housing to the poor? DPU Working Paper No.154. The Bartlett Development Planning Unit. UCL.
- Kissick, D, Leibson, D, Kogul, M, Bachmann, J., Anderson, J. and Eckert, J. (2006). Housing for all: Essential to economic, social and civic development. The World Urban Forum III, Vancouver, PADCO/ AECOM
- Knight, J. (1992). *Institutions and Social Conflict*, Cambridge: Cambridge University Press.
- Knight, T and Boyd, D. (2008). An investigation into how property developers use their social networks to drive development. In: Dainty, A (Ed) *Procs 24th Annual ARCOM Conference*, 1-3 September 2008, Cardiff, UK, Association of Researchers in Construction Management, 567-576.
- Maginn, P. and Thompson, S. and Tonts, M. (2008). Qualitative Housing Analysis: A Meta-Framework for Systematizing Qualitative Research. In Paul J. Maginn, Susan M. Thompson and Matthew Tonts. *Qualitative Housing Analysis: An International Perspective*. Volume 10, First Edition. Emerald Group Publishing Ltd, UK.

- Manzi, T. and Jacobs, K. (2008). Understanding Institutions, Actors and Networks: Advancing Constructionist Methods in Urban Policy Research. In Paul J. Maginn, Susan M. Thompson and Matthew Tonts. *Studies in Qualitative Methodology. Qualitative Urban Analysis: An International Perspective. Volume 9, First Edition.* Elsevier Ltd, UK.
- Marinescu, C. (2012). Transaction Costs and Institutions' Efficiency: A Critical Approach. *American Journal of Economics and Sociology, Vol. 71, No. 2.*
- Mooya, M.M. and Cloete, C.E. (2007). Informal Urban Property Markets and Poverty Alleviation: A conceptual Framework. *Urban Studies.* 44 (1) 147-165.
- Morgan, F.J. (2010). Residential property developers in urban agent-based models: Competition, behaviour and the resulting spatial landscape. A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Geography. University of Auckland
- North, D. (1991). Institutions. *Journal of Economic Perspectives* 5 (1) 97 – 112.
- Ndubueze, O.J. (2009). Urban housing affordability and housing policy dilemmas in Nigeria. A thesis submitted to the University of Birmingham for the degree of Doctor of Philosophy. Centre for Urban and Regional Studies School of Public Policy the University of Birmingham.
- Ojo, O., Olatoye-Ojo, O. and Gbadegesin, J.T. (2015). Bridging the Finance Gap in Housing and Infrastructure Provision through Private Finance Initiatives in an Emerging Economy. *Real Estate Finance*, 32(1), pp.16-22. Summer.
- Olotuah, A. O. and Bobadoye, S.A. (2009). Sustainable Housing Provision for the Urban Poor: A Review of Public Sector Intervention in Nigeria. *The Built & Human Environment Review*, 2, 51- 63.
- Oni, A.O. (2011). Harnessing real estate investment through proper tenant selection in Nigeria", *Property Management*, 29(4), pp. 383 – 397.
- Pepple. A.I. (2012). Achievements (29th May, 2011 –May 2012) Development of Enabling Sector Policies--National Housing Policy and National Urban Development Policy. Presentation on the ministerial platform of Federal Ministry of Lands, Housing and Urban Development, Abuja, Nigeria
- Pratiwi, D.D. (2005). Land Development Theories and Institutional Analysis: The operationalisation in housing and traditional communities. *Working Paper 2005.* Housing and Settlement Research Group. School of Architecture, Planning & Policy Development.
- Rashidi, T., Aukd, J. and Mohammadian, A. (2012). A Behavioural Housing Search Model: Two-Stage Hazard-Based and Multinomial Logit Approach to Choice-Set Formation and Location Selection. *Transportation Research.* 46, 1097-1107
- Smith S. J, Munro M. and Christie H.(2006). Performing (housing) markets. *Urban Studies* 43: 81-98
- Tang, Z. (2006). The Urban Housing Market In A Transitional Economy: Shanghai As A Case Study. Thesis Submitted to the Faculty of the Graduate School in partial fulfilment of the requirements for the degree Doctor of Philosophy in the Department of Geography, The Indiana University.
- Triantafyllopoulos N. (2008). A Heterodox Economics Approach of Property Market Efficiency. In *17th Annual American Real Estate and Urban Economics Association International Conference: Istanbul, Turkey.*
- Tipple, G. (1994). The Need for New Urban Housing in Sub-Saharan Africa: Problem or Opportunity". *African Affairs*, 93(373), pp. 587-608.
<http://www.jstor.org/stable/723668>.

- Ukoje J.E. and Kanu, K.U.(2014). Implementation and the Challenges of the Mass Housing Scheme in Abuja, Nigeria. *American International Journal of Contemporary Research Vol. 4, No. 4; April 2014*.
- Umoh, N. (2012). Exploring the Enabling Approach to Housing through the Abuja Mass Housing Scheme. Thesis Submitted to the Department of Urban Studies and Planning in partial fulfilment of the requirements for the degree of Master in City Planning. The Massachusetts Institute Of Technology.
- UN HABITAT. (2001). National Trend in Housing Production Practices (Vol. 4, pp. 60–69). Nigeria: United Nations Centre for Human Settlements.
<http://www.chs.ubc.ca/archives/files/HS-313.pdf>
- UN-HABITAT (2006). *National Trends in Housing –Production Practices Volume 4: Nigeria*, United Nations Centre for Human Settlements: Nairobi.
- UN-HABITAT (2010). *The State of African Cities 2010: Governance, Inequality and Urban Land Markets*. Nairobi: UN Habitat
- van Bortel, Gerard and Elsinga, M. (2007). A Network Perspective on the Organization of Social Housing in the Netherlands: the Case of Urban Renewal in The Hague, Housing. *Theory and Society*, 24(1), 32-48.
- van der Krabben, E.& and Lambooy, J.G.(1993). A Theoretical Framework for the Functioning of the Dutch Property Market”. *Urban Studies*. vol. 30 no. 81381-1397
- Van Ommeren, J.N. and M. Van Leuvensteijn (2005). New evidence of the effect of costs on residential mobility, *Journal of Regional Science*, 681-702.
- Van Ommeren, J. (2008). Transaction Costs in Housing Markets: the Role of Government Policy. VU University, FEWEB, De Boelelaan, 1081 HV Amsterdam, the Netherlands.
- Wakely, P. (2014). Urban public housing strategies in developing countries: whence and whither paradigms, policies, programmes and projects. DPU60 Working paper Series: Reflections, NO.163/60. The Bartlett Development Planning Unit.
- Whinston, Michael D. (2003). On the Transaction Cost Determinants of Vertical Integration.” *Journal of Law, Economics, and Organization*, 19(April), 1-23.
- Williamson, O. E. (1985). *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, New York: The Free Press.
- World Bank (2002). Brazil: Progressive Low income Housing: Alternatives for the poor.
- World Bank (2013). Africa Development Indicators.2013 International Bank for Reconstruction and Development / The World Bank 1818 H Street NW, Washington DC 20433.
- Woolthuis, R.K., Hooimeijer, F., Bossink B, Mulder, G., and Brouwer, J. (2013). Institutional entrepreneurship in sustainable urban development: Dutch successes as inspiration for transformation. *Journal of Cleaner Production*, 50 (2013), pp. 91-100.

A FACTORIAL ANALYSIS OF SAFETY PERFORMANCE MEASURES: A STUDY AMONG CONSTRUCTION WORKERS IN GAUTENG, SOUTH AFRICA

Okoro Chioma Sylvia; Musonda Innocent; Agumba Justus Ngala
Department of Construction Management and Quantity Surveying, School of Civil Engineering and the Built Environment, University of Johannesburg, Johannesburg, Gauteng, South Africa

Abstract

The health and safety (H&S) of construction workers has been a subject of much deliberation for decades. However, there is scant literature focusing on aspects of workers' safety performance (SP) relating to their unhealthy and unsafe eating behavior. The paper presents findings on an exploratory factor analysis of H&S performance measures. A 10-item questionnaire which was developed after an extensive literature review was used to collect empirical data on SP of construction workers in the Gauteng Province of South Africa. Results showed that SP could be reasonably measured by two constructs. The two constructs were clearly defined as trailing and prevailing. The emerged trailing measures were named lagging indicators while the prevailing ones were designated as leading indicators. The results lend support to extant literature which advocates the use of both leading and lagging safety performance indicators for effectively assessing construction workers' safety performance. The study provides evidence which could be beneficial in psychometric evaluation of construction workers' safety performance and behaviours on construction sites.

Keywords: Construction workers, Exploratory Factor Analysis, Gauteng, Safety performance

1 Introduction

The construction industry is fraught with accidents and deaths on an unacceptable level. This is in spite of its recognized contribution to socio-economic development with regard to contribution to Gross Domestic Product (GDP) and improvement in the quality of lives of an economy's citizens through job provision (Khan, 2008; Ofori, 2012). Although a decline in the number of fatal injuries in recent years has been indicated, statistics still report unacceptably high rates of accidents, injuries and fatalities (Musonda, 2012; Health and Safety Executive (HSE), 2014). The number and cost of injuries and deaths in the construction industry are deplorable and many of them are preventable (Janackovic et al., 2013). It is necessary to improve the H&S system continually in order to reduce the costs and increase companies' competitiveness and efficiency (Janackovic et al., *ibid.*).

Furthermore, attention to construction workers' H&S is crucial since they are at the centre of construction activities and as such are indispensable. Individual workers and their supervisors must make daily decisions about safety at work because it influences or competes with other performance facets of the job. These can be related to the task itself (e.g., safety vs. on-time delivery or productivity), or to the worker performing the task (e.g., safety vs. personal discomfort or extra effort) (Huang et al., 2013). Poor safety at work could result from workers'

unhealthy eating behaviours, among other things (Melia & Becerril, 2009; Lingard & Turner, 2015). In addition, the nature of construction work predisposes construction workers to hazards which pose a threat to their H&S. Such hazardous conditions may include extreme heights, machinery failure, welding emissions, unguarded machinery, which may lead to falls, being struck by heavy construction equipment, electrocutions, silica dust, asbestos, lead, accidents, structure collapses, and so on (ElSafty et al., 2012). Continuous attention to and integrated management of safety and health increases operational excellence and profitability in the sense that the occurrence of injuries and deaths is reduced, avoidable expenditure on on-site exigencies is reduced, productivity is increased, and in fact, morale and motivation among employees as well as implications of H&S are realised (Janackovic et al., 2013).

Much research has been conducted on H&S measurement and management (Lin et al., 2009) and in the construction industry specifically (Hinze et al., 2013; Lingard et al., 2013). However, most literature focused on the work environment, managerial and organizational aspects of H&S. Few studies have been devoted to safety performance measures related to the lifestyle behaviours of the workers which have been suggested to be unhealthy (Melia & Becerril, 2009). The present study identifies safety performance measures which could be related to workers' unhealthy eating behaviours and explores underlying structures of the measures. The objective of the current paper is to analyse the structure of the safety performance measures used in the study. The study could be useful to researchers and employers in the construction industry in assessing safety behaviours and performance of the workers.

2 Measuring Health and Safety Performance

According to Dingsdag et al. (2008), one of the most practical guiding principles of the measurability of safety performance is given in the Australian/ New Zealand Standard, *AS/NZS 4804: 2001 Occupational health and safety management systems—General guidelines on principles, systems and supporting techniques* (AS/NZS 4804) which defines safety performance as “the measurable results of the occupational health and safety management system related to the organisation’s control of health and safety risks, based on its OHS policy, objectives and targets” and measuring performance includes measurement of OHS management activities and results. This section discusses measures of assessing workers’ safety activities and results.

It has been generally acknowledged that the traditional metric used to measure H&S performance is a record of accidents, injury and ill-health statistics (Musonda, 2012). However, some researchers argue that measuring H&S performance by the frequency of accidents and injuries is sometimes inappropriate, unreliable and deceptive as gross under-reporting could occur (Musonda, *ibid.*). In addition, injury rates often do not reflect the potential severity of an event, merely the consequence; they reflect outcomes, not causes (Hinze et al., 2013).

In addition to injury and accident statistics, other measures reveal the state of safety performance of workers in an industry. ElSafty et al. (2012) opined that an Occupational Safety and Health Administration (OSHA) recordable injury is an occupational injury or illness that requires medical treatment more than simple first aid. First aid involves a particular level of treatment (such as cleaning and covering of wounds, use of non-prescription medication, etc; whereas medical treatment occurs when an injury or disease requires a higher degree of care and management to ensure a full recovery, for instance, treatment of fractures, suturing of wounds and prescribing and providing drugs to manage symptoms (Biggs et al., 2009; International Council on Mining and Metals (ICMM), 2014).

Other recordable criteria include death, restricted work, days away from work, significant injuries or illnesses diagnosed by physician and lost work day incidents (ElSafty et al., *ibid.*). Days away from work, restricted duty and transferred duties are related to injuries which are

severe enough that workers are away from work, placed on restricted duty or assigned a lighter job because of the injury. Supporting this view, the ILO stated that loss of working capacity or inability to perform normal or routine work functions on the next calendar day after an injury reflects poor worker safety performance (ILO, 2003). Statistics on the days away from work or on restricted duty due to an injury are useful when analyzing how much loss is incurred from injuries (ElSafty et al., 2012). Lost work day or lost time injuries are also useful in interpreting solutions to lowering the number of injuries and fatalities per year (Dingsdag, 2008; ElSafty et al., 2012). Absence from work due to an injury, for more than three consecutive working days is considered serious and compensable (ILO, 2003; Cameron & Duff, 2007).

According to Farooqui et al. (2008), the use of personal protective equipment (PPE) is one of the basic practices required for safety on construction sites. It is a performance issue which belongs to self-protection category and can be used to indicate safety performance levels of firms (Farooqui et al., *ibid.*; Biggs et al., 2009; Construction Industry Institute (CII), 2014). Workers face bodily harm when they do not wear (correctly) PPE. For instance, falls from heights could occur with weak scaffolding and lack of safety belts; cement burns could be sustained without protective gloves and boots while cementing; injuries could be sustained on fingers, eyes, head, or feet due to absence of PPE, and so on (Farooqui et al., 2008).

Another performance issue which is critical is the assessment of risks involved in a given task before embarking on it. The identification of the tasks, hazards and the risks of a job prior to work enables implementation of protective measures to ensure that work is done safely (Campbell Institute, 2014).

Furthermore, near-misses or close calls were shown to be indicators of safety performance ((Biggs et al., 2009; Hinze et al., 2013; CII, 2014). Reporting of the near-misses and/or accidents is also crucial in reflecting workers' attitude and commitment to safety at the workplace. However, according to Masood et al. (2014), the workers may be uncertain about reporting accidents or near-misses because sometimes there is no mechanism for compensation for injuries, and/or they may blame their luck which made them victims of the accident.

The above-mentioned indicators relate to construction workers, prior to or after an incident, and were therefore adopted as the indicators of worker safety performance, in the current study. This implies that some indicators may be trailing (also called lagging indicators), providing data about incidents after the fact (Hinze et al., 2013), whereas others may be prevailing (called leading indicators), potentially leading to an injury or incident (Biggs et al., 2009). Both leading and lagging indicators reflect safety performance (Hinze et al., 2013; Lingard et al., 2013). According to Atkins (2011), the use of a set of safety performance indicators provides a greater indication of safety performance than concentrating on one measure in isolation (or indeed a small number of random measures). Good safety performance indicators should be quantifiable and permit statistical inferential procedures and should be valid and representative of what is to be measured (Roelen and Klompstra, 2012). The interpretations should relate to the system and its operational context (Herrera, 2012).

3 Research Methodology

To achieve the objective of the study, a review of literature related to safety performance of workers in general and construction workers in particular was conducted. Various sources including academic and professional journals, books, government reports, newspapers, magazines, theses and dissertations were consulted. A 5-point likert-scale questionnaire was thereafter developed to elicit information workers' safety performance on construction sites. The identified items related specifically to those measures which could be associated with unhealthy eating, since this was the purpose of the main study. The questionnaire, which consisted of 10 items, was pilot-tested, reviewed and revised by experts (consisting of the

researcher's supervisors and a statistician). The final questionnaire had response categories were assigned 1, 2, 3, 4 and 5, for "on every project", "more than two times", "two times", "once before" and "never", respectively. Therefore, higher scores were meant to represent higher safety performance.

The questionnaire was self-administered to construction workers on building and civil engineering construction sites in Midrand, Samrand, Johannesburg and Centurion. The participants, selected through heterogeneity and convenience sampling, included workers who were actively engaged in the physical construction activities as opposed to the site managers and supervisors. This group was chosen as they were the most susceptible to poor safety performance on construction sites. A cover letter accompanied the questionnaire to explain the purpose of the study and obtain informed consent. The respondents participated voluntarily and anonymously. Out of a total of 220 questionnaires, 183 were completed and used for the empirical analysis.

The raw data were analysed using Statistical Package for Social Sciences (SPSS) version 22. The Cronbach's alpha and mean inter-item correlations were used to assess the internal consistency reliability of the scale. Factor analysis using principal axis factoring and oblimin rotation was then conducted to examine underlying structures of the theorized variables. However, prior to the factor analysis, preliminary considerations for the factorability of data were assessed. The sample size requirement of 150+ was met (Pallant, 2013). The Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests were also used to assess factorability. Missing data were excluded using listwise deletion. The data were however skewed, concentrating on the "never" category. Outliers were identified and removed before analysis. The Kaiser's criterion (retaining eigenvalues above 1), scree test (retaining factors above the "breaking point") were used to determine the emerging components or empirical constructs.

3.1 Validity and Reliability

Various measures were taken to ensure that the variables developed from extant literature (termed theoretical constructs in the current study) and those realised after the factorial analysis (termed empirical constructs) were valid and reliable. Through an extensive and thorough literature review and synthesis, expert reviews and validation as well as pilot-testing, construct validity of the theoretical variables was achieved (Olson, 2010). The Cronbach's alpha internal consistency reliability test was used to statistically assess the internal consistency of the ten theoretical variables as well as the two empirical constructs including lagging indicators (comprising absence from work for more than three days due to an injury, medical treatment beyond first aid, restricted work, near-misses, injury and sickness at work, and reporting of accidents) and leading indicators (consisting of risk assessment prior to performing a task, accepting any kind of work regardless of risks involved, and failure to wear PPE).

The resulting values, presented in table 1, indicated good internal consistency of the constructs. Before factor analysis, the scale was considered to be reliable and representative of what is to be measured, with a good alpha index of 0.83 (Roelen and Klompstra, 2012; Pallant, 2013). After analysis, the internal consistency reliability of the constructs, tested using both the Cronbach's alpha and mean inter-item indices, was equally good. Cronbach's alpha values of above 0.7 indicate acceptable internal consistency reliability and mean inter-item coefficients ranging from 0.2 to 0.4 indicate good internal consistency (Pallant, 2013).

Table 1. Internal consistency reliability of empirical constructs

	Cronbach's alpha	Mean inter-item correlations	Number of items
Lagging measures	0.885	0.530	7
Leading measures	0.763	0.521	3

4 Findings and Discussion

Prior to performing the factor analysis, suitability of the data for factor analysis was tested. The KMO value was 0.832, exceeding the recommended value of 0.6 and the Bartlett's test of sphericity reached statistical significance at $p = .000 (< .05)$, supporting the factorability of the data. The correlation matrix which showed the presence of many coefficients of 0.3 and above also supported the suitability of data for factor analysis.

Factor analysis of the ten items revealed that only two components had eigenvalues above 1 (4.511 and 1.885) as shown in Table 2, and the results of the scree test (Figure 1) also supported that only the first two components accounted for approximately 64% of the variance. The two components were thereafter rotated to reveal their item-loadings (Table 3). Seven of the factors strongly loaded on the first component, while the remaining three loaded on the second. The two components were then adopted as the empirical constructs.

Table 2. Percentage variance explained by the safety performance measures

Factor		Total	% of Variance	Cumulative %
1	been away from work for more than three days due to an injury	4.511	45.106	45.106
2	been treated medically for injuries (more than simple first aid) on site	1.885	18.851	63.958
3	been asked to do limited work after an injury	.815	8.148	72.106
4	been involved in incidents or near-misses	.710	7.097	79.202
5	been injured at work	.594	5.938	85.141
6	been sick at work	.451	4.506	89.647
7	failed to report an accident or incident	.330	3.297	92.944
8	failed to consider the possible risks in a particular task	.296	2.959	95.903
9	accepted any kind of work, not minding the danger/risk involved	.235	2.353	98.256
10	failed to wear personal protective equipment (PPE)	.174	1.744	100.000

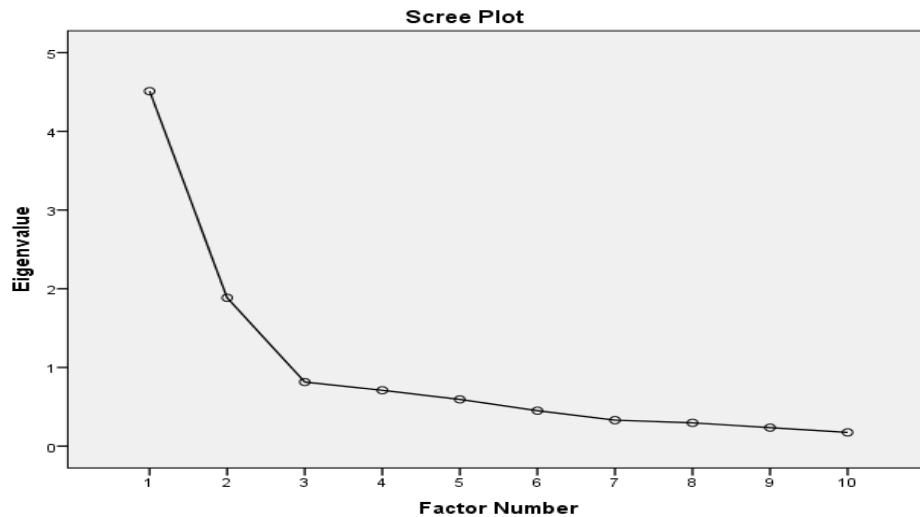


Figure 1. Scree plot showing constructs above the breaking point

Table 3. Loading matrix of the safety performance measures

Measures	Component		
	1	2	
1	been away from work for more than three days due to an injury	.946	-.119
2	been treated medically for injuries (more than simple first aid) on site	.872	-.009
3	been asked to do limited work after an injury	.813	-.177
4	been involved in incidents or near-misses	.670	.011
5	been injured at work	.651	.289
6	been sick at work	.613	.049
7	failed to report an accident or incident	.465	.258
8	failed to consider the possible risks in a particular task	-.073	.850
9	accepted any kind of work, not minding the danger/risk involved	-.036	.704
10	failed to wear personal protective equipment (PPE)	.124	.564

The interpretation of the two components showed that positive measures clumped together and negative measures did the same, consistent with positive and negative schedule scales used in extant literature (Pallant, 2013). Hence, the first component with negative items was named *lagging indicators*, while the second component with positive items was named *leading indicators* (ICMM, 2014).

In relation to construction safety performance, prevailing performance measures are leading indicators which provide information that prompt actions to achieve desired outcomes and/or avoid unwanted outcomes whereas trailing performance measures are lagging indicators that provide safety results, for instance, the extent of worker injuries (Hinze et al., 2013). Differentiating and using both indicators provide a more reliable and/or accurate measurement of safety performance (Lingard et al., 2013). Leading metrics can be useful in predicting future levels of safety performance, thereby providing information which could guide implementation of interventions to improve and impact positively on the safety process, before any negative (trailing) incidences occur (Hinze et al., *ibid.*).

The study provides support to extant literature which advocates the use of both leading and lagging indicators to measure safety performance in the construction industry. Traditional measures of safety, which are after-the-fact measures that assess safety after injuries occur, has

a shortcoming in the sense that it bases measurement on failure of the system (Dingsdag et al., 2008; Farooqui et al., 2012). Pre-emptive actions need to be taken before accidents occur. Leading indicators can help to predict safety levels to engender the necessary pro-active measures before the occurrence of accidents. Therefore, leading indicators should ideally be included in assessing of worker safety performance levels. This is even more important for assessing construction worker safety performance in order to reduce the risks associated with working in an inherently unsafe environment. In addition, the attitude and behaviour of construction workers with respect to safety is influenced by their trepidations of risk, safety, rules, procedures and management (Masood et al., 2014). Although leading indicators may be cumbersome to collect and measure, may not directly reflect actual success in preventing injury and/or disease, and may be subject to random variation (Dingsdag et al., 2008), they are increasingly becoming adopted (Lingard et al., 2013; Hinze et al., 2013). Equal consideration should be given to leading measures. A combination of both classifications to support behavioural changes can lead to sustainable worker safety levels in the long run. The use and adoption of both should be encouraged to drive H&S continuous improvement (Construction Owners Association of Alberta (COAA), 2011).

5 Conclusion and Further Research

The study sought to explore the underlying structure of safety performance measures. Safety performance was found to be measured by two components. The components had positive and negative safety performance measures, respectively. They were therefore named leading and lagging measures, accordingly. Lagging and leading measures should therefore be used to evaluate and effectively manage safety performance of construction workers.

The study provides evidence which could be useful in psychometric evaluation of construction workers' safety performance and behaviours on construction sites. By highlighting safety performance/behaviours of the workers, construction stakeholders could be enabled to make informed decisions regarding improving H&S performance of the workers, and thus improve the productivity, profits and competitiveness in their establishments. The limitations of the current study warrant mention. Firstly, the study was conducted in only one province in South Africa and may not be generalized to workers in the entire country or other countries. Secondly, the method of data collection was quantitative. More in-depth information could have been elicited with a follow up qualitative technique such as interviews, especially to shed more light on the "never" category responses. Future studies could therefore attempt the study using a different approach to extract more information or determine if dissimilar results would be obtained.

6 Acknowledgement

This research was supported by the University of Johannesburg through its Global Excellence and Stature Scholarships. The current paper is part of a recently completed Master's study at the University.

7 References

- Atkins, W. S. (2011). Development of suitable safety performance indicators for level 4 bio-containment facilities: Phase 2. Health and Safety Executive (HSE).
- Biggs, H. C., Dingsdag, D. P., Kirk, P. J. and Cipolla, D. (2009). Safety Culture Research: Leading indicators and the development of safety effectiveness indicator in the construction sector. *Proceedings of the 5th International Conference on Knowledge, Technology and Society*, 30Jan – 1 Feb., 2009. Huntsville, Alabama: Unites States of America.

- Cameron, I. and Duff, R. (2007). A critical review of safety initiatives using goal setting and feedback. *Construction Management and Economics*, 25(5):495-508.
- Campbell Institute. (2014). Practical guide to leading indicators: Metrics, case studies and strategies. National Safety Council: United States of America.
- Construction Industry Institute (CII). (2014). Measuring safety performance with active safety leading indicators. CII.
- Construction Owners Association of Alberta (COAA). (2011). Workplace health and safety performance improvement guideline: A best practice of the COAA. Canada: COAA.
- Dingsdag, Donald P. and Biggs, Herbert C. and Cipolla, Dean. (2008). Safety effectiveness indicators (SEI's): Measuring construction industry safety performance. *Proceedings Third International Conference of the Cooperative Research Centre (CRC) for Construction Innovation – Clients Driving Innovation: Benefiting from Innovation*, Gold Coast, Australia.
- ElSafty, A., ElSafty, A. and Malek, M. (2012). Construction safety and occupational health education in Egypt, the European Union and United States firms. *Open Journal of Civil Engineering*, 2:174-182.
- Farooqui, R. U., Arif, F. and Rafeeqi, S. F. A. (2008). Safety performance in construction industry of Pakistan. *Proceedings of the First International Conference on Construction in Developing Countries*, August 4-5, Karachi, Pakistan.
- Health and Safety Executive (HSE). (2014). Statistics on fatal injuries in the workplace in Great Britain. HSE Books.
- Herrera, I. A. (2012). Proactive safety performance indicators. *Unpublished Doctoral Thesis*. Norwegian University of Science and Technology, Norway.
- Hinze, J., Thurman, S and Wehle, A. (2013). Leading indicators of construction safety performance. *Safety Science*, 51(1):23-28.
- Huang, Y. Zohar, D., Robertson, M. M., Garabet, A., Lee, J. and Murphy, L. A. (2013). Development and validation of safety climate scales for lone workers using truck drivers as exemplar: Transportation research part F. *Traffic Psychology and Behaviour*, 12:5-19.
- International Council on Mining and Metals (ICMM). (2014). Health and safety performance indicators. ICMM, London: United Kingdom.
- International Labour Organization (ILO). (2003). Safety in numbers: Pointers for global safety culture at work. ILO, Geneva.
- Janackovic, G. I., Savic, S. M. and Stankovic, M. S. (2013). Selection and ranking of occupational safety indicators based on fuzzy AHP (Analytical Hierarchy Process): A case study in road construction companies. *South African Journal of Industrial Engineering*, 24(3):175-189.
- Khan, R. A. (2008). Role of construction sector in economic growth: Empirical evidence from Pakistan economy. *Proceedings of the First International Conference on Construction in Developing Countries*, August 4-5, Karachi, Pakistan.
- Lin, S., Tang, W., Miao, J., Wang, Z and Wang, P. (2008). Safety climate measurement at the workplace in China: A validity and reliability assessment. *Safety Science*, 46:1037-1046.
- Lingard, H and Turner, M. (2015). Improving the health of male, blue collar construction workers: A social ecological perspective. *Construction Management and Economics*, 33 (1):18-34.
- Lingard, H., Wakefield, R. and Blismas, N. (2013). “If you cannot measure it, you cannot improve it”: Measuring health and safety performance in the construction industry. *Proceedings of the 19th CIB World Building Congress*, 5-9 May, Queensland University of Technology, Brisbane: Queensland.

- Masood, R., Mujtaba, B., Khan, M. A., Mubin, S., Shafique, F. and Zahoor, H. (2014). Investigation for safety performance indicators on construction projects. *Sci. Int.(Lahore)*,1403-1408,2014
- Melia, J. L. and Becerril, M. (2009). Health behaviour and safety in the construction sector. *Psicothema*, 21(3): p.427+
- Musonda, I. (2012). Construction health and safety performance improvement: A client-centred model. *Unpublished Doctoral Thesis*. University of Johannesburg, South Africa.
- Ofori, G. (2012). New perspectives on construction in developing countries. Routledge.
- Olson, K. (2010). An examination of questionnaire evaluation by expert reviewers. *Field methods*, 22(4):295-318.
- Pallant, J. (2013). SPSS survival manual: A step by step guide to data analysis using IBM SPSS. 5th edition. Allen and Unwin, Australia.pp. 101, 193, 199 and 207.
- Roelen, A. L. C. and Klompstra, M. B. (2012). The challenges in defining aviation safety performance indicators. Preprint for PSAM II and ESREL, 25-29 June, 2012, Helsinki: Finland.

QUALITY MANAGEMENT A FUNDAMENTAL BUSINESS IMPERATIVE FOR CONSTRUCTION COMPANIES

Mthi, Vuyolwethu Feza Philisa; Allen, Christopher James

*Department of Construction Management, School of the Built Environment, Faculty of Engineering,
Built Environment and Information Technology, Nelson Mandela Metropolitan University, Port
Elizabeth, Eastern Cape, South Africa*

Abstract

The quality of construction projects in South Africa has long been below par which is evident in the reports of poor project performance, poorly implemented construction processes or worse projects delivered at an unexpected cost to the client. Private and public sector clients are dissatisfied with the quality of work produced by contractors, the rectification of substandard construction work on many of the low-cost housing projects throughout South Africa has left the state with a bill of around R50 billion. As a result this research suggests that company's implement quality management systems as a means to differentiate themselves from current industry performance. The research inquiry was conducted through the use of a case study (Bay West City Mall). Data was collected primarily through participant observation and survey questionnaire with the various participants of the Bay West City Mall project. The collected data were extracted, errors eliminated/accounted for, coded and entered onto an excel spreadsheet for easy reference and analysis. For the interpretation of the data the researcher used the bivariate tabulation method where categorical data is measured using ordinal and nominal scales. The study concluded that the employment of quality management systems should no longer be seen as optional but as fundamental to the continual improvement of construction companies, those organizations that fully institutionalise the principles of quality management will have a strong chance of improving their project performance, reducing project costs, getting repeat business and increasing profits on projects. It is the recommendation of this study that more research be conducted into how quality management, in the construction industry, can assist in alleviating other problems that plague the South African construction industry such as poor performance relating to health & safety, cost, time, low profit margins and poor cultural practices.

Keywords: Business management, Construction; Project pPerformance; Quality management; South Africa

1 Introduction

During the past decade the construction industry has been criticised for its poor performance and productivity in relation to other industries (Honnakker, 2010: 953). The Construction Industry Development Board (2010: 2) study *Construction Quality in South Africa: A Client Perspective* revealed that public sector clients were neutral or dissatisfied with the quality of construction on around 20% of all projects surveyed in 2009. While the CIDB Construction Industry Indicators (CII's) reported that for the year 2008 around 18% of the projects surveyed had levels of defects which are regarded as inappropriate, and clients were neutral or

dissatisfied with the quality of work delivered on 20% of projects, in 2010 clients were neutral or dissatisfied with 15% of projects surveyed and around 12% of projects surveyed had defects which are regarded as inappropriate and a noticeable decrease in satisfaction among clients was observed with increasing project size.

The Movement for Innovation (2010) found that construction industry clients want their projects delivered on time, on budget, free from defects, efficiently, right the first time, safely and by profitable companies. While regular clients expect continuous improvement from their construction team to achieve year on year reductions in project cost and reductions in project time. Therefore as Seneratne and Jayarathna, (2012: 101) put it, the construction industry needs to move towards higher quality, and contractors need to upgrade the quality of their services. In order to make this move organisations in other industries turned to quality management as a reliable management tool in the competitive market environment that leads to higher project performance (Seneratne and Jayarathna, 2012: 101). Sullivan (2011: 212) describes Quality Management as any approach to achieve and sustain a high quality output by conforming to requirements and meeting customer satisfaction requirements. Much research has been done with regard to the implementation of Quality Management Systems (QMS) and Elwary and Shabayama (2008: 156) believe that an organisation experiences the benefits of higher customer satisfaction, better quality products, and higher market share after the adoption of a QMS. According to Elwary and Shabayama (2008: 156) a QMS has the single purpose of improving the performance of one's business.

With the changing construction environment and the reported cases of dissatisfied clients it is necessary that studies be conducted to reveal the importance of Quality Management Systems and how they can not only turn around the trajectory of a single organisation, but that of the industry as a whole. A failure to conduct these investigations presents a risk to business in that it will be difficult to rectify poor quality on projects so that companies can eliminate cost overruns, improve client satisfaction and increase turnover. Thereby making the construction sector a less favourable investment solution for investors.

Construction Industry Development Board, (2011: 41) suggests that industry regulation bodies' and Government advocate for and strengthen the requirements for the appointment of professional services and contractors based on quality criteria.

2 Literature Review

The modern quality movement has only been with us for a few decades, it still has far to go before becoming widely operational among world economies (Maguad, 2006: 201). Therefore, it will probably take many more decades if not a century for the quality management discipline to mature and for nations and economies to digest this change (Magaud, 2006: 201). Nevertheless Maguad (2006:201) is confident quality will continue to become an imperative for the survival of organizations and national economies. He further asserts that the 21st century may well become known to historians as the Century of Quality.

2.1 Performance improvement and why it is important

Construction Industry Indicators (2010: 3) report that the contractor's survival depends on repeat work from clients, which is linked to the contractor's performance in past projects, contractors need to provide value for money to the client, as existing clients award contracts on the performance of the contractor on past contracts. Gharakhani et al., (2013: 46) observe that improving the quality with which an organization delivers its products and services is crucial for competing in an expanding global market. As the construction industry is now a highly dynamic sector, industry structures and product characteristics are changing at an ever-increasing pace (Seneratne and Jayarathna, 2012: 101).

With the changing economic environment, managers of construction companies and projects need to look for emerging construction management philosophies to keep up with the demands of the industry and its clients' (Seneratne and Jayarathna, 2012: 101). Hoonakker et al., (2010: 953) report that many of the management practices used to support construction organisations are being challenged, the industry's clients are moving forward, clients demand improved service quality, faster delivery and more innovative buildings.

2.2 The role of QMS in performance improvement

Delgado-Hernandez and Aspin (2008: 919) conducted a study called *Quality Management Case Studies in the UK Construction Industry* and found, that companies that have Quality Management Systems in place have won repeat business, increased their market shares and improved their customer satisfaction levels. Cagnazzo et al., (2010: 312) found strong evidence that ISO 9000 certification leads to improved performance, improved management and operational processes, which results in less waste of time and material, increased productivity, and cost saving. While Din, et al., (2011: 1047) report that quality management systems are not limited to influencing production based processes, but lend themselves to the improvement of financial procedures, risk management practises and information management among others. It is evident from studies by Cagnazzo (2010), Taticchi and Fuiano (2010), Chachadinha 2009, Coffey (2011), Willar and Trigunarsyah (2011), and Seneratne and Jayarathna (2012) that the use of ISO 9000 is associated with an increase in financial performance that brings benefits to companies' and stakeholders. Ghodbane, (2014: 68) confirms that QMS help organisations to optimize operations and increase sales, improve quality, provide cost savings and strengthen customer satisfaction.

To improve the performance of construction organisations and reduce project costs Davis et al. (1989), Abdul-Rahman (1993; 1995), Low and Yeo (1998), Love and Li (2000) stressed the need to measure quality costs. Costs associated with failure arise both from internal and external sources. Internal poor quality costs increase an organisation's cost of operations, for example, rework and material waste. External poor quality costs, however, result in loss of profits through contractual claims, defect rectification (rework), and the loss of future business (Jafari and Love, 2013: 1245). QMS provides a framework for measuring quality costs. Certified quality management systems can provide a solution for several issues in a construction company; it constitutes a good opportunity for restructuring and modernization, as well as changes in traditional ways that have been accepted without in depth analysis (Chachadinha, 2009: 245).

2.3 Quality Management and its impact on the business

Cagnazzo et al. (2010: 313) reports that the adoption of QMS yields visible concrete benefits to organisations in the form of increased customer satisfaction. He further writes that certified organisations are praised by researchers and scholars alike for being aware of customer requirements, having processes/activities that are designed to increase customer satisfaction, have systems to avoid misunderstandings about client instructions, systematically review contracts, and have systematic process for handling complaints.

Prince (2008: 15) discovered that QMS had the following long term effects on organisations that implement them;

- Improvements in product and service quality
- Production system improvements
- Productivity improvements
- Cost reductions in material and labour
- Reduction in cycle times and improved delivery

- Maintaining an “improvement” culture

Sidumedi (2006: 17) found that the dominant South African firms have recognized the benefits that could be derived from certified Quality Management Systems and have relentlessly pursued and have subsequently been awarded ISO 9000 certification.

2.4 Importance of certification

In his study, Sidumedi (2006: 16) observed that inspections were the dominant measure of addressing quality problems. However, Gharakhani et al., (2013: 48) states that in order to achieve quality on construction projects contractors must do more than conduct inspections, inspections are an inadequate control measure as they fail to address the root of the problem. Gharakhani et al., (2013) add that the inspection stage is too late; contractors must aim to reduce defects during production and eliminate mass inspection through the use of structured quality management systems.

Cagnazzo et al. (2010: 314) and (Ghodbane, 2014: 68) discovered that ISO 9000 certification increases a firm’s revenue as firms are able to enter new markets, increasing their potential to get new contracts and their ability to enter international markets. Din et al., (2011: 1044) observed that the advantages of a certified QMS clearly outweighed the inconveniences and the investment of resources involved as ISO 9000 certified companies’ have enhanced levels of performance in their projects compared to those that are not certified.

Results of a study by Liu (2003) on quality implementation in public housing projects in Hong Kong showed increased customer satisfaction after ISO 9000 implementation. Furthermore, the average number of defects in housing projects built by companies with ISO 9000 certification was significantly less than the number of defects in housing projects built by companies without ISO 9000 certification. Corbett et al. (2005) studied the impact of ISO 9000 certification on the financial performance of listed companies in three American economic sectors, over a period of 10 years (1988-1997). The authors stated that certification leads to an improvement of financial performance for firms that had a comparable level of economic performance before starting ISO programs.

Din et al. (2011: 1046) and Coffey et al. (2011:403) report that new regulations in Malaysia required Grade G7 contractors, the highest grade, to be certified with the ISO 9000 QMS as a compulsory condition of registration by January 1st, 2009. Failure resulted in being downgraded, which adversely impacts on the ability to do business. Such initiatives by government to improve quality in the industry will compel companies to adopt quality management systems. Malaysia is not alone in this process Australia, Hong Kong and Singapore have imposed regulations for construction firms to be ISO 9000 certified in order to qualify to bid for public sector projects. There is a global move towards certification and companies that operate globally that neglect to get a certified quality management system may soon find that they do not meet the required standards in some of the markets they previously operated in without difficulty.

3 Research Methodology

This study was conducted in two parts an observation / participation case study and a survey within the case. The survey was conducted amongst participants of the case in order for the phenomena observed to also be described from the participant’s view. The study was conducted over a period of 12 months. The research design employed was mostly qualitative although some aspects of quantitative were borrowed during the interpretation of the data.

The sample population was chosen using the *maximum variation* sampling strategy described by Merriam (2009: 82) and consisted of 54 persons in management positions and of these 21 responded. Respondents ranged from the Project Manager, Designers (Architects and

Engineers), and Contracts Managers to Site Foremen. Palys (2008: 2) wrote that searching for cases or individuals who cover the full spectrum of positions and perspectives in relation to the phenomenon one is studying, allows the researcher to capture both extremes (negative/positive, high/low,) and typical cases plus any other positions that can be identified.

Primary data were obtained through participant responses to the research questionnaire/survey, participatory observations made by the researcher and physical sources, while the secondary data came from the researched literature and these were used for (1) the description of contemporary and historical attributes (2) comparative research (3) reanalysis (asking new questions of the data that were originally not asked and (4) research design and methodological advancement.

Raw data were extracted from the questionnaire coded and plotted on an excel spreadsheet, errors and omissions were corrected and missing variables allocated a code such that no data was incorrectly entered as that may produce false results.

The responses on each questionnaire were recorded horizontally, under a separate heading as suggested by Struwig and Stead (2009: 151).

The bivariate tabulation method as discussed by Struwig and Stead (2009: 152) was used to tabulate the data. All questions in the questionnaire required categorical data, two types of measurement scales were used namely; nominal and ordinal.

The interpretation is coherent and accounts for all the data, although it must be noted it is seldom possible to account for every utterance by the research participants or every paragraph in a large document such as this (Struwig and Stead, 2009: 154).

4 Findings and Discussion

4.1 Case observations

This case examines the implementation of a quality management system (QMS) on large construction project by a South African construction company. At the start of the project the contractor had been operating for 112 years albeit since inception the organisation has become a large construction group operating on six continents. The organisation employs around 4000 employees.

The Bay West City Mall is a Regional Shopping Centre of approximately 90 000 m² situated in the Hunters Retreat area, west of Port Elizabeth in the Eastern Cape. The project population consisted of a Client, Development Manager, Investors, Project Manager, a design team of Architects and Engineers, Tenant coordinators, Leasing agents, Branding agents, Main Contractor, Nominated / Selected Subcontractors and Domestic Subcontractors.

The quality management system was based on the contractors SHEQ Policy (Safety Health Environmental and Quality) which encapsulates the company's mission, visions and goals. These form the basis of the project specific project quality plan, which was drafted and presented to the client for approval.

The project had a construction value of R900mil of that approximately R1, 2 mil was lost through rework, defective workmanship, waste, material failures and other quality issues. However, the existence of quality management system was what allowed the contractor to quantify the value of money lost through quality issues. The contractor was able to recover as much as R 121 444, 73 from selected subcontractors and R38 334, 14 from labour only subcontractors through the non-conformance system. Considering the overall construction value R1, 2 mil makes 0.13% of R900mil, which is less than 1%.

These issues were not only quantified, but the system also calls for an accurate description and investigation into the root cause of quality issues, preventative measures and proposed action,

which minimises the possibility of the same errors reoccurring. On a monthly basis a report is compiled highlighting the most prevalent quality problems experienced onsite, this information is presented to the contractor’s project manager, contracts managers and site agents who manage the foremen. Foremen are advised on what to look out for and resources are invested towards reducing the likely hood of these issues reoccurring.

Where necessary the system records which subcontractors are responsible for the most costly non-conformances, what is the most prevalent root cause and which trade has the highest number of defects, all this historic data is important for the contractor to understand where his shortcomings are and plan on how to reduce them on the project going forward, but also eliminate them on future project this facilitates continuous improvement on the contractors part.

The client was updated regularly on the performance of the project, through his agents and project reports this allowed the client to form a perception of the contractor and how well or poorly he was performing on the project. The presence of a structured system for recording and rectifying non-conformances boosted the client’s confidence in the contractor’s ability to manage the risk of poor quality.

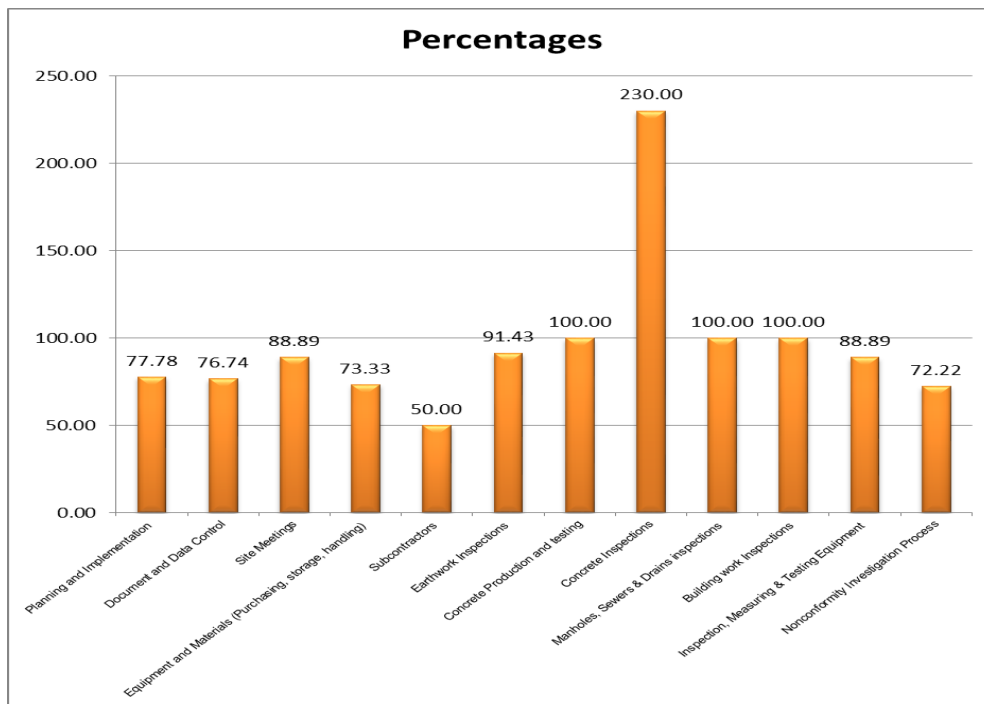


Figure 1. Audit results

Non-compliance to system and processes	70
Partial compliance to system and processes	100
Compliance - room to improve	150

Figure 2. Audit results

Figure 1 seen above shows a graphical representation of an audit conducted by the main contractor and shows that the highest score was achieved in concrete inspections and the lowest score was from sub-contractor performance. This showed the contractor that when it comes to quality his staff had a high focus on inspections and sub-contractors were provided very little guidance and management, which is not the correct view of quality this provided the contractor with an opportunity to change his focus and attempt to achieve a more level graph.

The contractor was able to get more business from the client, in the form of two additional but separate contracts these were negotiated with the main contractor before the client approached other bidders. The cost of rework on the project amounted to less than 2% of the contract value. Employee morale was raised as milestones were met and employees wanted to improve their statistics, wastage was reduced drastically because the main contractor kept a record of material orders versus requirements and was able to track where wastage was highest and resolve, newer employees were inducted on safety as well quality on their arrival and because all their peers were actively managing quality they easily adapted. Employees were sent on training courses to improve their knowledge and management skills, contracts managers took an active position in ensuring quality on the project, with time allocated to discussing quality at all formal site meetings.

The contractor was able to continually improve his processes as the staff got familiar with the quality system, however, it did not stop there a needs analysis project was initiated by the quality management department to assess the shortfalls of the quality system and suggest solutions. One of the shortfalls identified was that the staff did not fully comprehend the impact the quality management system was having on the project and therefore did not see the 'real' value of the system. This was overcome by showing the employees a record of their non-conformances and how much they had cost the company and it was presented to them how a collaborative effort between themselves and the quality department would not only reduce non-conformances but would lead to improved performance in terms of quality of work and delivery time.

4.2 Survey Findings

A survey was conducted amongst the participants of the case, the survey had questions/statements relating to five hypotheses. The sample population consisted of 54 persons in management positions and of the 54 only 21 responded giving a 39% response rate. Respondents ranged from the Project Manager, Designers (Architects and Engineers), Contracts Managers, Site Foremen and sub-contractor staff.

The questions and responses from the questionnaire could not all be tabled in this paper, however, Table 1 shows a summary of the hypotheses generated from this study through literature review and observation, these were then confirmed/supported by the data collected from the survey questionnaires.

Table 1. Hypotheses summary

Hypothesis Number	Description	Hypothesis Supported	Inconclusive	Hypothesis Rejected
1	Implementation of a certified Quality Management System leads to improved contractor performance on projects.	x		
2	Quality Management Systems are a fundamental business imperative.	x		
3	A construction company with a certified Quality Management System has a competitive advantage over one that does not have a quality management system	x		
4	The implementation of certified quality system allows a company to continually improve its processes and outputs.	x		
5	Quality management systems allow companies to meet client quality requirements		x	

Overall responses from the survey showed that respondents agreed that the existence of a certified quality management system does lead to improved contractor performance, a wide range of researchers agree that QMS leads to improved project performance as well as financial and organisational performance (Cagnazzo 2010, Taticchi and Fuiano 2010, Chachadinha, 2009, Coffey 2011, Willar and Trigunarysah 2011, Seneratne and Jayarathna, 2012).

Respondents viewed the existence of certified quality management systems as a fundamental business function. In his study *A study of challenges small black electrical contractors in Durban and Pietermaritzburg areas are faced with that could lead to their failure* Myeza (2006) found that successful growing firms use low-cost strategies to compete. They compete with high-quality products and superior service and adopt continuous improvement strategies. They also take advantage of new opportunities and adopt formal and professional approaches to people management. Customer care is crucial customers are not interested in the problems that the firm has but are concerned with what can be obtained from the interaction of the two parties. Losing valuable customers could be detrimental to the business survival (Myeza 2006: 20). QMS is a suited to achieving the success factors listed by Myeza (2006: 20).

Responses support the hypothesis “*A construction company with a certified Quality Management System has a competitive advantage over one that does not have a quality management system*”. Cagnazzo, Taticchi, and Fuiano (2010); and Magaud (2006) suggest that companies with certified quality management systems have a competitive advantage over those that do not.

The majority of respondents strongly agreed that quality management systems allowed companies to continually improve their processes. When QMS is applied as an ongoing process it results in continuous improvement (Elghamrawy and Shibayama 2008: 156). Magaud (2006); and Chachadinha (2010) discovered that the main purpose of the ISO 9000 standards is to achieve an effective management system that focuses on continuous improvement, communications, and meeting customer requirements.

Findings were inconclusive for the hypothesis “*qms allows a company to meet client requirements*”.

5 Conclusion and Further Research

The aim of this study was to highlight how important certified quality management systems have become in today's construction environment and how contractors should really begin to see the use/implementation of quality management systems as the next step in improving their business performance. Through the use of a quality management system the main contractor at Bay West City Mall was able to keep his rework related costs low, react to risks better, build his clients confidence, continuously improve his overall performance on the project through acting on lessons learnt from previous projects and even achieve some lesser known benefits of QMS's such as increased employee involvement, open communication and behavioural changes in employees.

The use of a certified QMS leads to long-term return on investment that is not only higher but also more sustainable. The study revealed that companies that use QMS are able to improve their performance, being renowned for quality makes it easier to get repeat business. Literature revealed that at present the concept of QMS was receiving utmost attention from larger construction companies while small and medium sized enterprises tended to postpone this step. On the same token QMS are a highly credible solution to challenges faced by small and medium sized enterprises such as poor customer retention, lack of continual improvement and the failure to adopt formal and professional approaches to business. There are difficulties and problems to overcome, however, the implementation of a thorough Quality Management System will permanently change the company's modus operandi in ways that could be uncomfortable for employees and / or management, nevertheless the advantages of QMS are undeniable.

It is the recommendation of this study that the South African government and industry regulation bodies (CIDB, NHBRC, BIFSA etc.) look at ways of increasing quality whether it be with push factors such as; making it compulsory for contractors wanting to undertake work for government to have a certified QMS in place or pull factors such as preference being given to contractors that can show their commitment to quality and end the practice of awarding business on price alone. Industry professionals/ client's agents should advice clients' not to appoint based on price alone but on quality criteria. Lastly studies should be conducted, as variable outcomes amongst companies using QMS lead to the hypothesis that there must exist critical elements in implementation. Identifying these elements could be the push required for companies not yet sold on quality management.

6 References

- Cagnazzo, L., Taticchi, P. & Fuiano, F., 2010. Benefits, barriers and pitfalls coming from the ISO 9000: implementation: the impact on business performance. *WSEAS TRANSACTIONS on BUSINESS and ECONOMICS*, 7(4), pp. 311-321.
- Chachadinha, N. M., 2009. Implementing Quality Management Systems in Small and Medium Construction Companies: A contribution to a road map success. *Leadership and Management in Engineering*, pp. 32-39.
- Coffey, V., Willar, D. & Trigunaryyah, B., 2011. *Quality Mnagement System and Construction Performance*. Brisbane, IEEE Xplore Digital Library.
- Construction Industry Development Board, 2010. *Results of 2010 CIDB Construction Industry Indicators*, Pretoria: CIDB.
- Construction Industry Development Board, 2011. *Construction Quality in South Africa: A Client Perspective*, Pretoria: cidb.
- Delagado-Hernandez, D. J. & Aspin, E., 2008. Quality Management case studies in UK construction industry. *Total Quality Management*, 19(9), pp. 919-938.
- Din, S., Abd-Hamid, Z. & Bryde, D. J., 2011. ISO 9000 certification and construction project

- performance: The Malaysian Experience. *International Journal of Project Management*, Issue 29, pp. 1044-1056.
- Elghamrawy, T. & Shibayama, T., 2008. Total Quality Management Implementation in the Egyptian. *Journal of management in Engineering*, 3 July, 24(3), pp. 156-161.
- Gharakhani, D., Rhamati, H., Farrokhi, M. R. & Farahmandian, A., 2013. Total Quality Management and Organisational Performance. *American Journal of Industrial Organisation*, 1(3), pp. 46-50.
- Ghodbane, B. S., 2014. The Effect of Quality Management on Business Performance: Case of Tunisian Firms. *International Journal of Information, Business and Management*, 6(4), pp. 67-72.
- Hoonakker, P., Carayon, P. & Loushine, T., 2010. Barriers and Benefits of quality management in the construction industry: An empirical study. *Total Quality Management*, 21(9), pp. 953-969.
- Jafari, A. & Love, P. E., 2013. Quality Costs in Construction: Case of Qom Monorail Project in Iran. *Journal of Construction Engineering and Management*, 139(9), pp. 1244-1249.
- Magaud, B. A., 2006. The Modern Quality Movement: Origins, Development and Trends. *Total Quality Management & Business Excellence*, 17(2), pp. 179-203.
- Merriam, S. B., 2009. *Qualitative Research: A Guide to Design and Implementation*. San Francisco: Jossey Bass.
- Myeza, M. P., 2006. *A study of challenges small black electrical contractors in Durban and Pietermaritzburg areas are faced with that could lead to their failure*. Pietermaritzburg: University of Kwa-Zulu Natal.
- Palys, T., 2008. *Purposive Sampling*. Burnaby: Simon Fraser University.
- Prince, S. N., 2008. *Assessing quality management systems of SMME's in the manufacturing sector*. Port Elizabeth: Nelson Mandela Metropolitan University.
- Seneratne, S. & Jayarathna, T., 2012. Quality Planning Process of Construction Contractors: Case studies in Sri Lanka. *Journal of Construction in Developing Countries*, 17(1), pp. 101-114.
- Sidumedi, K. S., 2006. *An investigation into the relationship between the corporate culture of South African construction firms and performance*. Johannesburg: University of Witwatersrand.
- Smallwood, J. J., 2012. *Quality Management in Construction*. Cape Town: Nelson Mandela Metropolitan University.
- Struwig, F. W. & Stead, G. B., 2009. *Planning, designing and reporting research, 5th ed.* Cape Town: Pearson Education South Africa.
- Sullivan, K. T., 2011. Quality Management Programs in the Construction Industry: Best Value Compared with other Methodologies. *Journal of Management in Engineering*, 27(4), pp. 210-219.

STRATEGIES FOR EFFECTIVE MATERIALS MANAGEMENT TOWARDS SUSTAINABLE CONSTRUCTION ENHANCEMENT

Solanke, Bukola H.; Fapohunda Julius A.

Department of Construction Management and Quantity Surveying Faculty of Engineering, Cape Peninsula University of Technology, Cape Town, Western Cape, South Africa

Abstract

Despite the significance of the construction industry in developed and developing nations, construction activities tend to have adverse impacts on environmental and socio-economic aspects of society. This paper aims to evaluate the impact of construction materials management on materials usage efficiency towards the enhancement of sustainable building construction in the Western Cape Province of South Africa. The study adopts a quantitative research approach. Closed-ended questionnaires were administered to seventy (70) construction professionals in different construction companies in the Western Cape. The data obtained were analysed using the Statistical Package for Social Sciences (SPSS). Strategic planning before procurement at design stage, procurement strategy considered for materials purchase, enforcing the adoption of Green Building Councils of South Africa (GBCSA) policy in every construction projects in the country and evaluating the life-cycle analysis (LCA) of materials proposed for use were acknowledged as the predominant factors of materials management that enhance the construction of sustainable buildings. This study was delimited to construction professionals (project managers, procurement officers, engineers, and architects), contractors and company suppliers in the construction industry in the Western Cape Province of South Africa. The adoption of sustainable materials management principles during construction will have the following implications: increased competition amongst material manufacturers, leading to a reduction in material cost which will facilitate economic advancement; and a reduction of material wastage during construction by ensuring availability of material when required on site. Effective materials management during sustainable construction remains a significant attribute of a successful project which ensures waste reduction, cost profitability optimization and government participation in sustainable development through policy implementation related to construction.

Keywords: Construction materials management, Materials selection, Materials usage, Sustainable building construction, Sustainable development

1 Introduction

The construction industry is a significant contributor to the social, economic and environmental development of a country. Sustainability is *‘the ability to meet the present needs of humans without compromising the ability of the future generations meeting their own needs’* (Du Plessis, 2007). Social, economic and environmental aspects of the human existence is also known as the ‘Triple Bottom Line’ (TBL). According to Asif, Brujin, Fisser and Steenhuis, (2008) TBL is a framework used in measuring the impact of human activities on the environment, the economic and social well-being of humans in a territory. Sustainable building

construction is a process aimed at restoring or maintaining a balance between built environment and the eco-system to create a settlement that promotes economic and social equity (Osec, 2010). Achieving sustainability in construction through the adoption of the principles of sustainability is therefore expedient towards human development and environmental protection.

Environmental issues in the last century have lightly been considered as a major problem in construction (Nagapan, Rahman, Asmi, Memon and Latif, 2012). However, recent studies have shown that these challenges are complex in nature as it affects the well-being of the society. The process of materials usage during the cycle of construction has imposed increasing damages to the environment over the years through illicit consumption of materials and illegal wastes disposal (Ljungberg, 2007). As a result of this increasing negative impacts of construction, mitigating measures such as legal frameworks, technical, strategic and managerial processes should be adopted at the pre and post phases of construction (Du Plessis, 2007). Gaustad, Olivetti and Kirchain (2011) added that the key strategy towards materials usage efficiency is the adoption of the four Rs of sustainability (Reduction, Reuse, Recycle and Renew).

This paper sets to evaluate the impact of construction materials management on materials usage efficiency towards the enhancement of sustainable building construction. Firstly, a literature review was conducted to establish a background for the study. Based on literature the factors that enhance efficient materials management were identified to form the basis for data collection and data analyses were carried out to determine and rank the factors considered during materials selection to facilitate optimum materials usage.

2 Construction Materials Management

Construction materials are a collection of materials utilized at any stage or phase of construction (Samarasinghe, Tookey, Rotimi and Thiruchelvam, 2012). Hillebrandt (1988) cited in (Samarasinghe *et al.*, 2012) noted the existence of a strong relationship between various construction projects and the materials used in the construction. Samarasinghe *et al.*, (2012) added that the success of a project towards stakeholders' satisfaction at minimum cost and time is dependent on the management process of materials used for construction. The value of construction materials used in a project has been confirmed to claim 40-70% of the total cost of construction which contributes to a significant measure of construction wastes (Kasim, 2011; Nagapan *et al.*, 2012). In affirmation, Donyavi and Flanagan (2011) highlighted that the total cost of construction is relatively high as a result of the material cost, procurement cost and the site-handling costs which includes the cost of transportation, cost of receiving, storage, issuing, and disposal. Thus, for reduced construction cost, increased productivity, quality and timely project delivery, effective materials management must be of top priority to the project manager (Donyavi and Flanagan, 2009).

Materials management is thus defined as a plan or control adopted during construction to improve the flow of materials and to ensure that the appropriate quality and quantity of materials required for particular activities are acquired at a reasonable cost and when needed. To Patel and Vyas (2011), sustainable materials management is an integrated approach towards the reduction of materials wastages during construction in order to increase cost profitability, materials optimization and environmental protection. From the planning phase of the building to the selection of materials and disposal or recycling of materials waste during building production, the adoption of life-cycle analysis improves the chances of achieving the goals of sustainability. Thus, the aim of materials management is to reduce the adverse impact of materials usage during construction on the environmental and social well-being for a sustained economic prosperity.

With regards to achieving sustainability, it should be noted that materials used in construction determines the functionality, quality and other properties of the building regardless of the expertise involved during construction (Karana, Hekkert and Kandachar, 2010). However, it is vital for the project manager to understand the process of materials flow analysis (MFA) to determine the mass or quantity of materials used during production. The MFA is also known as Domestic Materials Consumption (DMC), used for the purpose of quality control and construction waste reduction (Fiksel, 2006). The process of materials flow analysis (MFA) involves several strategic methodologies, techniques and tools such as Life Cost Assessment, (LCA), Life Cycle Costing (LCC), Building for Environmental and economic sustainability (BEES), dematerialization, detoxification and other government established policies (Khalfan, Maqsood and Noor, 2011).

Materials selection in sustainable construction is being conducted in various ways which are guided by the same principles. These principles according to Ljungberg (2007) include the following:

- Function and structural demands of the building
- Environmental impacts
- Design
- Technological demands
- Cost of materials
- Construction method adopted

Remarkably to this effect, several sustainable materials management (SMM) policies have been launched by the South African government with regards to waste generation, quality control, environmental protection and sustainability realization. Policy bodies such as the Green Council of South Africa (GBCSA) and the South African Bureau of Standards (SABS) were established to raise awareness on the benefits of sustainable building and to facilitate and encourage the adoption of sustainable practices in the industry. The governments in some other developing countries such as Japan, China and Korea have adopted comprehensive policies and regulatory approaches relating to the reduction of material consumption, resource recycling, waste production and disposal, to ensure socio-economic equity and environmental justice during and after the building production process. Examples of these government policies as identified by Fiksel, (2006) include product life-cycle policies, waste management policies and natural resources policies. In addition, the integration of government policy should focus on the issues of materials management in an approach that transcends all boundaries of management (Fiksel, 2006).

Materials management towards sustainable construction simply poses an indispensable aspect of project management which aids in dissociating excessive material consumption from the increasing growth recorded in the construction industry. Hence, materials management during sustainable construction remains a significant attribute for successful project delivery.

3 Methodology and Methods

The study adopted a closed-ended questionnaire survey designed to examine the impact of construction materials management on materials usage efficiency towards the enhancement of sustainable building construction. This study identified fifteen materials management strategies considered during materials selection, thirteen factors that facilitate materials usage and eight approaches to materials usage towards enhancement of sustainable construction. Due to the vast size of the South African construction industry, the survey was delimited to the Western Cape Province. Data collection was conducted using the cluster sampling technique from construction industries situated in the Central Business District (CBD) of Cape Town. This

technique was adopted in order to obtain precise data with generalizable conclusions from companies in the district.

The questionnaire design adopted the five point Likert scale and was administered by hand to two principle target groups. These groups are government establishments and private companies. These groups were selected because of their significant function in the construction supply chain and because their perceptions would be highly valuable to this research. In order to explicitly gain their perceptions, the target groups were sub-divided into site managers, project managers, architects, quantity surveyors, contractors, procurement officers and company suppliers. The Cronbach's alpha reliability test was conducted on the research questions to ensure the reliability of the questionnaire. A total of seventy (70) questionnaires were administered to aforementioned groups to ascertain the perspectives of the respondents on construction materials management and usage efficiency towards the enhancement of sustainable building construction. Forty-three copies (61%) of the questionnaires were retrieved after numerous phone calls, and visitation to the construction sites and consulting offices. This was observed to be as a result of the respondents' busy schedules on site, considering the positions they occupy in their organisations. Data analyses were conducted using the descriptive statically analysis in the Statistical Package for the Social Science (SPSS) version 23.

4 Data Analysis and Discussion of Findings

4.1 Data Analysis

Biographical information of respondents

Table 1 provides an overview of the respondents' background information in terms of profession and company information, working experience and highest qualification.

From the table, a high percentage of the survey respondents are working with contracting firms (30%), 33% work with government establishments, 14% work with quantity surveying companies and 21% work with engineering firms. The results reflect that 14% of the respondents have between 1-5 years' experience, 32.6% have between 6-10 years' experience, 27.9% of the respondents have between 11-15 years' experience, 18.6% of the respondents have between 16-20 years' experience and 6.9% of the respondents have had over 25 years' experience. Figure 4.1 illustrates the highest qualification obtained by the respondents, the result show that 29% of the respondents obtained National diplomas and 9% obtained Master's Degree while the majority obtained Bachelor's degrees (62%). The results of the analysis on respondents demographic and background information have shown that the respondents sampled were qualified and experienced practitioners in the construction industry whose judgments on issues of construction materials procurements can be reliable.

Table 1. Biographical information of respondents

QUESTIONS		VALID %	FREQUENCY
Participating company	Contractors	30.2	13.0
	Engineering	20.9	9.0
	Quantity Surveying	14.0	6.0
	Suppliers	2.3	1.0
	Government Establishment s	32.6	14.0
Company Specialization	Residential buildings	32.6	14.0
	Public buildings	16.3	7.0
	Both	51.1	22.0
Working experience	1-5years	14.0	6.0
	6-10years	32.6	14.0
	11-15years	27.9	12.0
	16-20years	18.6	8.0
	Above 20years	6.9	3.0
Profession	<i>Procurement officers</i>	32.6	14.0
	Quantity surveyors	18.6	8.0
	Site engineers	23.3	10.0
	Project managers	25.5	11.0

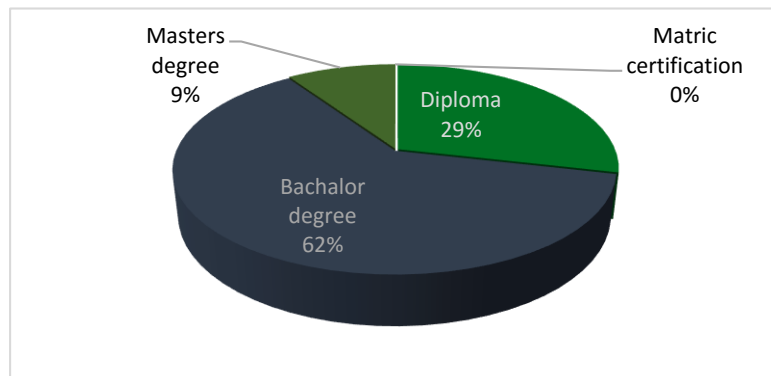


Figure 1. Highest educational qualification obtained

Table 2 shows the results obtained from the Cronbach's alpha test conducted on the questions to ensure the reliability of the research questions. Cronbach's alpha reliability test is an estimate of the internal consistency associated with the scores that can be derived from a scale or composite score (Allen, 2004). From the table, it is observed that the Cronbach's alpha coefficient values are greater than 0.70 (>0.70). To supports this, Tavakol and Dennick (2011) stated that the score values between 0.70- 0.90 are the standard acceptable values for the reliability of a test to be proven.

Table 2. Reliability of the survey tool/instrument

Headings	No. of items	Cronbach's alpha values
Materials management strategies considered during materials selection	15	0.88
Materials usage facilitators	13	0.85
Approaches to materials usage backed by government policies	8	0.75

4.2 Data analysis and Discussion of findings

4.2.1 Strategies for Construction Materials Selections during sustainable construction

Table 3 presents the results of data analysed on management strategies considered during materials selection for optimum materials usage. The respondents were required to rank the importance of these strategies towards enhancing sustainable construction. Strategic planning before procurement at design stage (mv=3.84), procurement strategy considered for materials purchase (mv=3.79), competence Level of the workforce required for construction (mv=3.79) and the environmental impact of the materials emerged as the most important factors to consider during materials selection (mv=3.72). Isa *et al.* (2014) supported the adoption of the findings in their study, stating that the planning process at the early stage is the most important process conducted in managing the life-cycle of the building project. Isa *et al.* (2014) argued that the planning phase of a building project is the most strategic phase to integrate the principles of sustainability, determine the procurement strategy to be implemented and evaluate the possible environmental impact of the materials proposed for construction.

Table 3. Construction materials strategies considered during materials selection

Strategies	Mean value (mv)	Rank
Strategic planning before procurement at design stage.	3.84	1
Procurement strategy considered for materials purchase.	3.79	2
Competence level of the workforce required for construction.	3.79	2
The environmental impact of the materials	3.74	3
Selection of SABS approved materials	3.72	4
Total involvement of clients at the design stage	3.72	4
Effects of materials cost fluctuations on cost of construction	3.72	4
General site organization which may affect the flow of materials on site	3.70	5
The level of communication between the workforce during construction	3.70	5
Availability of required materials in the market.	3.65	6
Availability of adequate materials storage facility	3.16	7
The sustainable nature of materials (recyclable or renewable materials)	3.12	8
Materials specifications take-off from building designs	3.07	9
Choice of building design by stakeholders	2.98	10
Properties of the materials required for construction	2.79	11

4.2.2 Materials usage facilitators

Table 4 presents factors considered in facilitating materials usage efficiency towards sustainable building construction. The respondents were required to rate the factors based on a five point agreement scale. 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4=agree and 5=strongly agree. Proper project planning from the inception using sustainable building design was ranked as the top facilitator of effective materials usage by the respondents and 88.4% of the respondents agree that proper project planning from the inception using a sustainable building design (mv=4.21) improve the flow of construction resources on site and workforce productivity. Implementing government policies and laws regarding usage or disposal of materials (mv=4.16), environmental impact of the materials proposed for use (mv=4.09) and proper understanding of clients ideas at the conceptual phase of design (mv=4.07) were also identified to significantly facilitate the effective usage of materials to enhance the building sustainability.

Table 4. Facilitators of materials usage efficiency

Facilitators	Strongly disagree (%)	Disagree (%)	Neither agree nor Disagree (%)	Agree (%)	Strongly agree (%)	Mean	Rank
Proper project planning from the inception using sustainable building design	0.0	0.0	11.6	55.8	32.6	4.21	1
Government policies and laws regarding usage or disposal of materials	0.0	0.0	14.0	55.8	30.2	4.16	2
Environmental impact of the materials proposed for use	0.0	2.3	11.6	60.5	25.6	4.09	3
Proper understanding of clients ideas at the conceptual phase of design	0.0	7.0	9.3	53.5	30.2	4.07	4
Efficiency of the materials procurement strategy in place during construction	0.0	4.7	18.6	46.5	30.2	4.02	5
Timely delivery of construction materials to site	0.0	9.3	16.3	46.5	27.9	3.93	6
Implementing waste reduction techniques during construction	0.0	7.0	20.9	46.5	25.6	3.91	7
Effective communication amongst workers during construction	0.0	11.9	20.9	37.2	30.2	3.86	8
Early learning on sustainable building practices should be encouraged in institutes and universities	0.0	14.0	18.6	39.5	27.9	3.81	9
Staff innovations on materials usage for effective materials utilization	0.0	7.0	23.3	53.5	16.3	3.79	10
Using self-efficient material (durable, renewable and recyclable materials) to reduce construction waste	0.0	4.7	37.2	37.2	20.9	3.74	11

4.2.3 Approaches to materials usage backed by government policies

Table 5 presents approaches to effective materials usage during construction aimed at enhancing the adoption of sustainability in the industry. The respondents were required to rate the agreement of the items using a five (5) point Likert scale: strongly disagree =1, disagree =2, neither agree nor disagree = 3, agree =4 strongly agree = 5. Majority of the respondents 86.1% agreed that the Green Building Council of South Africa (GBCSA) policy on selection and usage of building materials be enforced in every construction projects towards the enhancement of sustainable building production. Ninety-point-eight per cent (90.8 %) of the respondents indicated that evaluating the life-cycle analysis (LCA) of materials proposed for use as important and 86.1% agreed that adopting the principles of recycling material wastes to reduce environmental pollution are top policies that must be considered in enhancing sustainability during construction materials procurement.

Table 5. Approaches to materials usage backed by government policies

Strategies	Strongly disagree (%)	Disagree (%)	Neither agree nor disagree (%)	Very effective (%)	Extremely effective (%)	Mean value
Enforcing the adoption of Green Building Councils of South Africa (GBCSA) policy in every construction projects in the country	0.0	14.0	25.6	37.2	23.3	3.70
Evaluating the life-cycle analysis (LCA) rating process of materials proposed for use	0.0	14.0	32.6	41.9	16.3	3.65
Adopting the principles of recycling materials wastes to reduce environmental pollution	0.0	14.0	25.6	41.9	18.6	3.65
Using renewable and reusable materials for construction	0.0	16.3	37.2	34.9	11.6	3.42
Adapting the principles of dematerialisation at every phase of construction	0.0	18.6	39.5	25.6	16.3	3.40
Adapting the use of alternative building materials(rammed earth, adobe etc) to reduce excessive consumption of manufactured materials	0.0	27.9	32.6	25.6	14.0	3.35
The use of Eco-friendly technologies during construction	4.7	20.9	32.6	27.9	14.0	3.26

5 Conclusions and Recommendations

Materials management “involves an integrated coordination of materials related functions such as taking-off, materials selection, vendor evaluation, purchasing, shipping, warehousing and distribution” (Linden and Josehson 2013). Effective selection and management of construction materials is identified as the easiest approach for project managers to incorporate sustainable principles in building construction project (Akadiri and Olomolaiye, 2012). This study evaluated the impact of construction materials management on materials usage efficiency and the identification of strategies for effective materials management towards the enhancement of sustainable building production in the Western Cape construction industry. The quantitative research approach was adopted in collecting empirical data. Data analysis indicated that strategic planning before procurement at the design stage is a significant approach to consider for effective materials management towards sustainable construction. Strategic planning before procurement at design stage gives engineers/contractors time to develop a feasible plan in meeting the building specifications with the available materials in the market. The building planning at the design phase involves the process of materials selection, ordering and scheduling. Based on the findings in this study, it can be concluded that a lapse in the planning process will negatively affect materials usage, workforce productivity, production cost (cost overrun) and construction resource wastages due to construction time delays. The findings suggested that to effectively manage construction materials’ towards the enhancement of sustainable construction, the adoption of the Green Building Councils of South Africa (GBCSA) policy in every construction projects is a strategy that must be considered for implementation by the construction profession. The findings also indicated that in enhancing the sustainability of buildings during production, the LCA is one of the most effective tools available to the contractors to holistically evaluate the environmental and economic impacts of using certain materials in the construction phases. Based on the finding, it can be concluded that the evaluation of the life-cycle analysis (LCA) ratings of materials proposed for construction is an essential strategy in ensuring sustainability in a building. There,

considerations of these strategies in materials management for efficient materials usage will ensure and enhance sustainable development in building design and construction.

This paper recommends that the planning phase of any construction project should be given enough time for extensive planning as this is the best stage of construction to integrate sustainability into the processes of production. This paper also recommends that strict implementation of government legislation on sustainable building production should be enforced to ensure compliance by construction stakeholders'. It further recommended that the South African government enacts the GBCSA policies into law to ensure compliance in the industry towards the enhancement of sustainable buildings production in the country.

6 References

- Akadiri, P. O., & Olomolaiye, P. O. (2012). Development of sustainable assessment criteria for building materials selection. *Engineering, Construction and Architectural Management*, 19(6), 666-687.
- Allen, K., "Explaining Cronbach's Alpha", available at <http://coecs.ou.edu/sci> under Publications. A paper is also being prepared with the findings
- Arain, M., Campbell, M.J., Cooper, C.L., and Lancaster, G.A. 2010. What is a pilot or feasibility study? A review of current practice and editorial policy. *BMC Medical Research Methodology*. <http://www.biomedcentral.com/content/pdf/1471-2288-10-67.pdf>
- Asif, M., Bruijn, E.J., Fisscher, O.A.M and Steenhuis, H.J. 2008. *Achieving Sustainability Three Dimensionally*. Proceedings of the 2008 IEEE, ICMT; pp. 423-28.
- Babbie E. 2007. *The Practice of Social Research*, Eleventh Edition. USA: Thomson Wadsworth
- Donyavi, S. and Flanagan, R. 2009. The impact of effective material management on construction site performance for small and medium sized construction enterprises. In: Dainty, A.R.J. (Ed) Proceedings 25th Annual ARCOM Conference, 7-9 September 2009, Nottingham, UK, Association of Researchers in Construction Management, 11-20
- Du Plessis, C. 2007. *A Strategic Framework for Sustainable Construction in Developing Countries*. *Construction Management and Economics*. Vol. 25: pp.67-76.
- Edwin, R. Teijlingen, V. and Hundley, V. 2001. Social research Update (ISSN: 1360-7898). Department of Sociology, University of Surrey, Guildford GU2 5XH, United Kingdom.
- Fiksel, J. 2006. A framework for sustainable materials management. *JOM*, 58(8), 15-22.
- Gaustad, G., Olivetti, E., & Kirchain, R. 2011. Toward sustainable material usage: evaluating the importance of market motivated agency in modeling material flows. *Environmental science & technology*, 45(9), 4110-4117.
- Gillham, B. 2000. *Developing a Questionnaire*. London: Continuum.
- Isa, N. K. M., Alias, A., & Abdul Samad, Z. 2014. Sustainability integration into building projects: Malaysian construction stakeholders' perspectives. *The Macrotheme Review*, 3(3), 14-34.
- Karana, E., Hekkert, P., & Kandachar, P. 2010. A tool for meaning driven materials selection. *Materials & Design*, 31(6), 2932-2941.
- Kasim, N. 2011. *ICT implementation for materials management in construction projects: Case Study*. KICEM Journal of Construction Engineering and Project Management.
- Khalfan, M. A., Maqsood, T. and Noor, M.A. 2011. Attitudes towards sustainable construction amongst construction contractors. *Built Environmental Journal*. Vol. 8, No. 2, 9-21
- Ljungberg, L. Y. (2007). Materials selection and design for development of sustainable products. *Materials & Design*, 28(2), 466-479.

Nagapan, S., Rahman, I. A., Asmi, A., Memon, A. H., & Latif, I. 2012, December). Issues on construction waste: The need for sustainable waste management. In *Humanities, Science and Engineering (CHUSER), 2012 IEEE Colloquium on* (pp. 325-330). IEEE.

OSEC 2010 Sustainable Construction in Southern Africa. Available online:

http://www.sge.com/en/filefieldprivate/files/6551/field_blog_public_files/796 [Assessed 9th June, 2014]

Tavakol, M and Dennick R. 2011. Making sense of Cronbach's alpha. *International Journal of Medical Education*.

<http://staff.neu.edu.tr/~cise.cavusoglu/Documents/ELT%20516/cronbachs-alpha2011.pdf>

THE IMPACT OF IMPLEMENTING BIM ON AEC ORGANISATIONAL WORKFLOWS

Akintola, Adeyemi; Douman, Darcelle; Kleynhans, Matthew; Maneli, Sithembisile
School of Construction Economics and Management, Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, Gauteng, South Africa

Abstract

The seemingly elusive pursuit of completing projects predictably, within the constraints of cost, time and quality requires the aggregation of information and integration of various project team member work processes. BIM has been put forward as a possible approach for achieving this aim, albeit with attendant challenges, prominent among these is the need for streamlining intra-organisational workflows. This study therefore sought to develop and understanding of how implementing BIM impacts organisational workflows with a view to enabling professionals make more informed decisions about adoption and implementation of BIM. Semi-structured qualitative interviews were conducted with three consultancy companies in Johannesburg, South Africa. Data in form of transcriptions and notes were descriptively coded in two cycles, and analysed thematically. This study found that resistance to change and high set-up and training costs are key impediments to the successful implementation of BIM. Furthermore, there were experiences of a loss of productivity during training and the development of standards, disconnects between project team members collaborating at lower or higher maturity compared to others, change in the sequence of project team activities, and the creation of new roles, such as a BIM coordinator/manager to facilitate the adoption and development of organisation specific standards and documents. These challenges can lead to varying patterns of adoption and implementation and consequently, a lack of interoperability of inter-organisational business processes. The findings are instructive on the need for unified industry strategy to facilitate the diffusion of BIM in the South African construction industry as in countries like the UK.

Keywords: BIM, Collaboration, Delivery, Maturity, Workflows

1 Introduction

The nature of the Architecture Engineering and Construction (AEC) industry is such that constant interaction through communication and sharing of information between various professionals is essential for successful delivery of projects (Crotty, 2012). Project delivery involves complex processes that require extensive collaboration for efficient management, amid global industry challenges to completing projects predictably, within the constraints of cost, time, and quality (Crotty, 2012; Fang and Marle, 2013). Further, as a result of the separation of design and construction functions, and the continued specialisation of construction industry practices into more specific fields of operation, the industry has grappled with its fragmented nature and project delivery processes (Nawi *et al.*, 2013). This is coupled with severe difficulties in aggregating construction information dispersed among project stakeholders (Latham, 1994; Egan, 1998; Nawi *et al.*, 2013). Consequences of these are sub-optimal levels of project performance. In the United States, evidence show that these challenges

contribute to about 15.8 billion dollars yearly losses through inefficiencies (Gallaher *et al.*, 2004).

As solutions to these challenges, the integration of multiple stakeholder work processes, and a shift from traditional competitive delivery methods towards integrated design and construction methodologies have long been advocated (Latham, 1994; Egan, 1998). Importantly, the use of integrative and collaborative technologies have been argued, and shown to be capable of providing the impetus for the required change (Howard *et al.* 1989). Building Information Modelling (BIM) is one such ‘technology’. A process of developing digital representations of construction components elements to simulate planning, design, construction, operation and maintenance of structures, BIM when implemented enables the rendering of several views of data about a structure in 2D (Simple CAD), 3D (Visualisation), 4D (Schedule), 5D (Cost), and 6D (Operations and Maintenance) in an aggregated model, and collaborative environment (Deutsch, 2011). Notwithstanding that Building Information Modelling authoring tools have been in existence since the late 20th century, clients and project teams have only recently become conscious of its benefits in delivering projects (Linderoth, 2010). Implementing BIM has been shown in practice to facilitate increased efficiency (Deutsch, 2011) increased productivity of professional organisations (Crotty, 2012) while also improving communication and collaboration (Wong *et al.*, 2011). Without doubt, the associated benefits are the main drivers of its adoption and implementation within the construction industry (Cao, 2015).

However, there are several barriers to successful implementation of BIM in the construction industry (Migilinskas, 2013; Arayici *et al.*, 2011). These include *inter alia*, the need for changing procurement culture (Rowlinson *et al.*, 2010), need for changing or adapting intra- and inter-organisational work practices and workflows (Porwal and Hewage, 2013; Bryde *et al.*, 2013), lack of clarity of stakeholder roles and responsibilities on BIM projects and varying degrees of experiential knowledge of BIM among project teams (Porwal and Hewage, 2013). This implies that organisation and project team work practices need to be aligned to BIM requirements to achieve success. Nonetheless, evidence from literature shows reluctance towards shifting from traditional work methods to adopting innovative approaches to project delivery among industry professionals (Arayici *et al.*, 2012). This may be attributable to deficient understanding of BIM adoption and implementation implications. A lack of knowledge about how implementation enables, and on the other hand, constrains organisational work practices may hinder wider adoption, and its successful implementation on projects. This study therefore seeks to develop an understanding of how professional service providers in the South African construction industry have implemented BIM within their organisations, and of how the implementation enables or constrains organisational workflows. This will enable implementers to make more informed decisions about how to implement BIM to realise the benefits accruable from its implementation.

2 Literature Review

Succar (2009) however, describes BIM as a set of processes, technologies and policies that work together to produce a methodology for digitally managing project information through the whole life cycle. Furthermore, Sebastian (2011) argues that collaboration between project stakeholders is the main premise on which BIM relies. Therefore, the key ideas that cut across these definitions are information aggregation, integration and collaboration among project stakeholders through the use of appropriate technology. This is at the core of the appeal of BIM to the construction industry. Nevertheless, it is important to note that BIM’s potential for enabling more efficient project delivery processes is a major driving force behind the growth in implementation, and indeed government demand, as in the United Kingdom (Cao, 2015). As Barlish and Sullivan (2012) put it, clients are willing to utilise BIM once they understand its capabilities and benefits. The benefits include improved efficiency, communication and

collaboration, increase in productivity, reduced project cost, time and rework (Migilinskas, 2013; Wong *et al.*, 2011; Cao, 2015). It is therefore evident that BIM implementation can positively contribute to project success and overall industry performance.

However, implementing BIM does not lead to guaranteed project success. Its implementation comes with attendant risks and challenges as is common with similar innovations. In fact, at the initial stages of adoption and implementation within organisations, it is likely to cause conflicts in the status quo, and temporarily reducing performance. The resolution of these challenges brings about transformation into a new status quo. This is depicted in Satir's model of change in Figure 1 below (Cameron and Green, 2012).

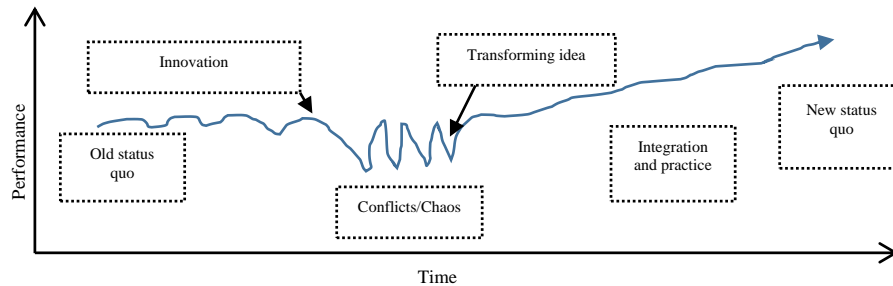


Figure 1. Satir's model of change (adapted from Cameron and Green, 2012)

To elucidate on this, the following section highlights evidence in literature, of challenges to successfully implementing BIM.

2.1 Challenges to successful implementation

Khosrowshahi *et al.* (2012) in consonance with the views of Linderoth (2010), posit that the slow adoption of BIM by organisations can be attributed to a lack of preparedness to make the required changes necessary for implementing BIM, combined with the misunderstanding of their roles and responsibilities on such projects. In a case study of a Swedish company, Linderoth (2010) found that the diffusion of BIM would depend on how well it fits in with user roles, responsibilities and competencies. Yet, the levels of BIM use across organisations and professionals vary greatly (Eadie *et al.*, 2015; Khosrowshahi *et al.*, 2014). Other challenges are fear of changing roles, responsibilities and work practices (Elmualim and Gilder, 2014). Kiprotich *et al.* (2014) in a South African study found that the BIM use in South Africa is largely isolated, and only to the extent of simple 3D modelling (visualisation) applications. A summary of BIM implementation challenges is show in Table 1 below.

2.2 Benchmarking BIM implementation capability and maturity

There have been a few attempts at benchmarking levels of collaborative working with BIM. Taylor and Bernstein (2009) employed a 4-level categorisation of BIM use into visualisation, coordination, analysis, and supply chain integration while Succar *et al.* (2012) developed five stages of BIM implementation maturity (initial, defined, managed, integrated and optimised).

Table 1. Challenges militating against successful implementation of BIM

Challenges militating against successful implementation of BIM	Singh, <i>et al.</i> , (2011)	Lawrence <i>et al.</i> , (2012)	Porwal and Hewage (2013)	Dossick and Neff (2010)	Elmualim and Gilder (2014)	Rowlinson <i>et al.</i> , (2010)	Khosrowshahi and Arayici (2012)	Owen <i>et al.</i> (2010)	Rekola <i>et al.</i> (2010)	Gu and London (2010)	Becerik-Gerber and Kensek (2010)
Industry's reluctance to change existing work practices/workflows	x		x		x		x			x	
Need for changing or adapting intra and inter organisational workflows/work practices			x	x	x			x	x	x	
Lack of clarity of stakeholder roles and responsibilities on BIM projects	x	x			x				x	x	
Need to train staff on new technology					x		x		x		x
Need to establish new process or workflows for delivery of projects					x			x	x	x	
Varied readiness to implement BIM across stakeholders	x		x							x	
Varying degrees of experiential knowledge and understanding within project teams							x		x	x	
Difficulty in maintaining completeness, quality and consistency of shared models					x				x		
Cultural barriers towards adopting new technology/cultural division within teams				x							x
Undefined fee structures						x					x
Difficulty in measuring costs/benefits of BIM implementation		x	x								
Software interoperability and data exchange issues									x		x
Lack of understanding of BIM capabilities, challenges		x									
Need for change in procurement culture						x					
Reluctance towards adoption due to time required to produce and maintain complete models							x				
Lack of understanding of other team members' workflows on BIM projects									x		
Ineffective collaboration among team members (modelling and model utilisation)											x
Need for investment in new IT infrastructure											x
Insufficient legal framework											x
Competition and lack of common interests among BIM authoring tool vendors											x

Nonetheless, in order to facilitate the achievement of the UK government's mandate that BIM be used at maturity level 2 for all public projects by 2016, the British Standards Institute (BSI) has developed the PAS 1192:2013 specification. It describes the levels of collaborating with BIM (BML) in generic terms as:

- BML-0: Unmanaged CAD with the use of 2 dimensional (2D)
- BML-1: Requires collaboration tool to provide a common data environment and established standard data formats. Cost data to be managed by standalone packages with no integration.
- BML-2: Collaborative environment to be of 3D form, held in separate discipline BIM authoring tools with attached data managed by Enterprise Resource Planning (ERP) Approach may also utilise 4D and 5D capabilities.

- BML-3: Fully open processes and data integration enabled by web-services. Compliance with relevant data exchange standards, managed by a collaborative model server.

2.3 Review synthesis

Building Information Modelling (BIM) is potentially useful for improving AEC industry performance. However, several associated risks and challenges need to be identified and mitigated. Consequently, successful implementation is not guaranteed. Therefore, it can be surmised from literature reviewed, that informed adoption and implementation decisions for AEC organisations in South Africa requires an understanding of its implications on their organisations workflow. This is the central focus of this study. The theoretical underpinnings of this study are in activity theory (understanding changing patterns of human activity on impact by technology) and role theory.

3 Research Methodology

3.1 Philosophical assumptions

This research is informed by subjectivist philosophical assumptions, where social phenomena are seen as being created from the perceptions of social actors and with a focus on individual meanings (Saunders, 2012; Creswell, 2013). The focus of this study is on developing an understanding of the experiences of professional service providers in implementing BIM within their organisations. A subjectivist ontological position is well suited to achieving this in that it emphasises conduction of research among people rather than about objects (Saunders, 2012). In consonance with this philosophical leaning, and with literature on studies with similar foci with this study, an interpretivist epistemology, albeit with a largely deductive approach to reasoning, is appropriate as it supports methods of knowledge gathering in participants' natural settings (Saunders *et al.*, 2012; Creswell, 2013). This is to facilitate an understanding of their experiences from their own point of view.

3.2 Research methods

Following from the philosophical choices made, this study is designed after the qualitative research tradition. This is suitable for exploring a problem in-depth (Creswell, 2013). Further, current research in the domain is mainly qualitative in nature. Gu and London (2010) employed focus group interviews (grounded theory strategy); Balish and Sullivan (2012) used cases studies, while Linderoth (2010) used semi-structured interviews with participant observational methods.

3.2.1 Data collection method and participant selection

Conversations are one of the best ways of obtaining systematic and in-depth knowledge (Kvale, 2008). Therefore, one-on-one semi-structured interviews, with professionals representing selected organisations, were considered the best way to collect data. In order to focus on unique case contexts, a heterogeneous purposive sampling technique was employed with snowballing (field referrals) to select participants for the study. Further, participants for this research were selected from consulting professional service providers in South Africa. This comprises Architectural, Quantity Surveying, and Engineering organisations. The selection criterion was mainly evidence of adoption and implementation BIM within the organisation. 3 interviews (2 Architectural and 1 Quantity Surveying organisation) were conducted, analysed and presented in the following sections. Notes and audio recordings were taken during the interview sessions to ensure all information is captured. The audio recordings were also transcribed (verbatim),

while handwritten notes and researchers preliminary reflections from the interview were summarised into analytic memos, one per interview (Miles *et al.*, 2014).

3.2.2 Method of data analysis

Data in form of notes and transcripts from the interviews were analysed thematically. Thematic analysis followed a two-step procedure. Texts were coded using broad descriptive codes (Miles *et al.*, 2014). First, notes and transcripts were read while also highlighting relevant portions of the material, and assigning descriptive words or phrases (pre-defined or developed as analysis progresses) to the highlighted chunks of textual data and refining same as analysis progresses. Second, codes were developed into key themes for each highlighted text (groupings or more finely coded) while considering interpretive themes from theoretical or practical positions of the study (Miles *et al.*, 2014).

4 Preliminary Findings and Discussion

4.1 Data Analysis and Findings

Table 2 describes the contexts of each organisation that participated in this study as the context is important to understand when analysing the data.

Table 2. Participant organisation contexts and implementation strategies

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
Context		
<ul style="list-style-type: none"> • Medium sized Architectural firm (staff is about 60nr) • Based in, Johannesburg • Established in 1945 • Projects are based in South Africa and internationally 	<ul style="list-style-type: none"> • International Quantity surveying firm (head office in the UK). • The Johannesburg office is one of 90 branches. • Established first international branch in 1982 • Projects are based in South Africa and internationally 	<ul style="list-style-type: none"> • Medium sized Architectural firm of about 200 employees • Based in Johannesburg with a branch office in Nigeria. • Projects are based in South Africa and internationally
Implementation strategies		
<ul style="list-style-type: none"> • Motivation for implementing BIM: improvement of job delivery workflows efficiency, competitive advantage, keeping up with evolving industry trends. • Implicit policy to implement BIM on all projects. • Each person in the organisation has access to the BIM authoring software and training • New computers and software licenses were purchased to facilitate adoption of BIM. • Formal implementation plan was drafted for training and implementing standards • BIM manager was hired to facilitate transitioning to BIM. 	<ul style="list-style-type: none"> • Motivation for implementing BIM: improvement of job delivery workflows efficiency • They have not implemented BIM in South Africa as part of a project team, but they have in the UK • Their staff have had training on how to use BIM authoring software • Organisation has achieved a capability for BIM level 1 here in South Africa but operating at a Maturity level between 0 & 1. 	<ul style="list-style-type: none"> • Motivation for implementing BIM: competitive advantage, keeping up with evolving industry trends. • In-house expert to coordinate BIM implementation and use internally (documentation management). • Staff have had access to the BIM authoring software and had training • The firm has achieved implementation Maturity level 1. • Formal implementation plan for achieving BIM maturity level 2 has been drafted). • Willing to start working towards BIM maturity level 3

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
<ul style="list-style-type: none"> Achieved a capability for BIM level 2 but presently operating at maturity level 		

Cases 1, 2 and 3 (shown in Table 2) represent experiences of BIM implementation from three organisations that are some of the most prominent professional practices in South Africa and will therefore be treated as key informants. It should be noted that since *Company B* (Quantity Surveying) have only implemented BIM as part of a project team in the UK. However, the staff have undergone training to acquire the capability to participate in BIM projects in South Africa, at least to BIM level 1. This is not farfetched as the diffusion of BIM naturally starts with lead design firms long before other allied professional organisation. Furthermore, while *Companies A & C* have only been operating at BIM level 1, interestingly, the momentum for level 2 BIM implementation (information sharing & coordination) has begun already (BSI, 2013). This is a significant development from Kiprotich *et al.* (2014)'s report of only isolated use of 3D modelling and visualisation applications of BIM in South Africa. Yet, these efforts are limited to intra-organisational drive for collaborative practices. Expectedly, as in the works of Wong *et al.*, (2011) and Cao (2015), the main motivation for implementing BIM for all the companies are the associated benefits (see Table 3).

Table 3. Experiences of benefits from Implementation BIM

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
<ul style="list-style-type: none"> Problem solving Improved design workflows Implementation of BIM being worthwhile Design clash detection Time and cost savings Improved communication, collaboration and integration within the organisation and with allied professionals Increased productivity and efficiency Capability for executing larger projects 	<ul style="list-style-type: none"> Cost savings Time savings Design clash detection Quick resolution of conflicts Improved accuracy Competitive advantage Increased delivery speed Increased productivity and efficiency 	<ul style="list-style-type: none"> Increased demand for firm's service Increased efficiency Able to execute projects quicker and better Design and construction risks are detected earlier More work done at lower cost compared to competitors More work is done earlier in the delivery process. Improved collaboration among teams Design clash detection Increased Productivity Increased project turnover

There are several commonalities in the experiences of the three organisations regarding the benefits from BIM implementation. These experiences are similar to the findings in existing literature (Wong *et al.*, 2011; Cao, 2015). BIM is perceived as being able to assist in problem solving, improving efficiency and increasing overall productivity. While all three organisations attest to increase in productivity, Company C further links this to increased turnover.

Table 4. Challenges to Implementing BIM

Case 1 (Company A)	Case 2 (Company B)	Case 3 (Company C)
<ul style="list-style-type: none"> • Mind-set shift • Resistance to change • Time consuming training • High software and update costs • Disconnect between consultants: where other consultants don't implement BIM, interoperability becomes an issue • More efforts required to develop good quality • Presentations when compared to traditional CAD 	<ul style="list-style-type: none"> • Resistance to change • 'BIM is all about technicalities' • Huge training requirements • High cost of BIM authoring software • 'BIM is mainly economically viable for large scale projects' • No BIM specialist in company's SA office • Technological advancements reduces relevance of experiential knowledge • Implementation is being driven mainly by BIM champions from large practices 	<ul style="list-style-type: none"> • Time consuming training • High software and update costs • Disconnect between consultants (lack of interoperability) Project team members' silo mentality' • Need for allied professionals to start evolving their design skill

Companies A & C report very similar experiences of challenges to implementing BIM (see Table 4). Importantly, resistance to change within their organisations and disconnect with other professionals (lack of interoperability of organisational business practices) are key challenges identified. These are two of the most prominent challenges to implementing BIM and can be deterrents to increased adoption and implementation within the construction industry. Collaboration through BIM is only as effective as the weakest link in the project team makes it. Further, down times experienced when learning to apply new technology impacts negatively on productivity (Cases 1&3). Company B's report is from a different perspective as Quantity surveyors, the participant mentioned that the lack of a BIM expert to facilitate implementation is a challenge. These suggest, however inconclusively, that experiences of challenges vary by organisation type. Nevertheless, for all three cases a common thread of evidence was that of declining productivity as a result of a substantial amount of training that is required to facilitate BIM implementation.

Table 5. Impacts of BIM on organisational workflows

CASE 1	CASE 2	CASE 3
<ul style="list-style-type: none"> • Downtimes while training and developing new organisational workflows to implement BIM • More efficient design workflows • Better integration of team design processes. • Increased productivity and efficiency • Increased capability for executing larger projects • Creation of new roles (BIM coordinator or BIM manager) 	<ul style="list-style-type: none"> • Improved efficiency and performance • Increased productivity and efficiency 	<ul style="list-style-type: none"> • Downtimes while training and developing new organisational workflows to implement BIM • More is done earlier in the delivery process • More time and resources are spent on the design phase, i.e. model development phase. • Increased productivity and efficiency • Creation of BIM coordinator/manager roles • Design and construction risks are detected earlier

Participants have had both positive and negative experiences of BIM impacts on organisational workflows (see Table 5). One impact of BIM that is rarely reported in literature is experiences of downtimes while training or developing new organisational workflows to implement BIM. Misunderstanding this may mean that organisations that are unable to overcome these challenge have to roll back on the implementation. Perhaps more importantly, Company C emphasised the temporal shift in effort for design and construction activities. This implies that more work is done earlier in the delivery process when the cost impacts of change in employer requirements are minimal effects on dependent activities. Furthermore, the findings suggest

that creation of a new role for BIM facilitation and coordination within firms is critical to the success of the implementation as in Porwal and Hewage (2013) and Sebastian (2011).

5 Conclusion and Further Research

This study sought to develop an understanding of how implementing BIM impacts the workflows of construction professional service providers in South Africa. This is on-going research. Nonetheless, thus far, the findings have far reaching implications. These impacts are structural and social in nature. Expectedly, the three cases presented associate several benefits with implementing BIM. Likewise there are experiences of many challenges that impinge on professional practice. The reports varied slightly due to the differences in level of capability and BIM maturity level within the organisations. Further, the requirement for in-house BIM facilitators or managers, expansion of professional responsibility, temporal shift in design and construction activities, and the need for new or restructured project documentation are enlightening. The results also reveal that BIM is being led mainly by design firms who employ in-house BIM experts to develop and maintain organisation specific standards and guidelines. This can lead to varying patterns of adoption and implementation and consequently, lack of interoperability of inter-organisational business processes. These findings suggest a need for unified industry strategy to facilitate the diffusion of BIM in the South African construction industry as in countries like the UK. This strategy may be driven by government or the private sector since it is clear that clients are the main drivers for BIM implementation, while also being the biggest beneficiaries of BIM benefits (e.g. aggregating and managing asset information). However, while there are competing arguments for or against either, the private sector, through entities like the South African Property Owners Association (SAPOA), which claims control of about 90 per cent of all commercial and industrial property in South Africa, are perhaps better positioned to drive a unified industry strategy for implementing BIM due to the sector's dynamic nature. This is an on-going debate. Future work will seek to expand on these ideas and document more experiences of BIM implementation in South Africa so as to increase the credibility of the research findings.

6 References

- Arayici, Y., Coates, P., Koskela, L., Kagioglou, M., Usher, C., and O'Reilly, K. (2011). Technology adoption in the BIM implementation for lean architectural practice. *Automation in Construction*, 20(2), pp. 189–195.
- Barlish, K., and Sullivan, K. (2012). How to measure the benefits of BIM — A case study approach. *Automation in Construction*, 24(0), pp. 149–159.
- Becerik-Gerber, B., and Kensek, K. (2010). Building Information Modeling in Architecture, Engineering, and Construction: Emerging Research Directions and Trends. *Journal of Professional Issues in Engineering Education and Practice*, 136(3), pp. 139–147.
- BSI (2013). *PAS 1192-2:2013 - Specification for information management for the capital/delivery phase of construction projects using building information modelling*. The British Standards Institution.
- Cameron, E., and Green, M. (2012). *Making sense of change management: a complete guide to the models tools and techniques of organizational change*. Kogan Page Publishers.
- Cao, D., Wang, G., Li, H., Skitmore, M., Huang, T., and Zhang, W. (2015). Practices and effectiveness of building information modelling in construction projects in China. *Automation in Construction*, 49, pp. 113–122.
- Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.
- Crotty, R. (2012). *The impact of building information modelling: transforming construction*. Routledge.

- Deutsch, R. (2011). *BIM and Integrated Design: Strategies for Architectural Practice*. New Jersey: John Wiley & Sons, Inc.
- Dossick, C., and Neff, G. (2010). Organizational Divisions in BIM-Enabled Commercial Construction. *Journal of Construction Engineering and Management*, 136(4), pp. 459–467.
- Eadie, R., Browne, M., Odeyinka, H., McKeown, C., and McNiff, S. (2015). A survey of current status of and perceived changes required for BIM adoption in the UK. *Built Environment Project and Asset Management*.
- Egan, J. (1998). *Rethinking Construction*. London: The Construction Task Force.
- Elmualim, A., and Gilder, J. (2014). BIM: innovation in design management, influence and challenges of implementation. *Architectural Engineering & Design Management*, 10(3/4), pp. 183–199.
- Fang, C., and Marle, F. (2013). Dealing with project complexity by matrix-based propagation modelling for project risk analysis. *Journal of Engineering Design*, 24(4), pp. 239–256.
- Gallaher, M. P., O'Connor, A. C., Dettbarn, J. L., and Gilday, L. T. (2004). *Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry*. Maryland: National Institute of Standards and Technology.
- Gu, N., and London, K. (2010). Understanding and facilitating BIM adoption in the AEC industry. *Automation in Construction*, 19(8), pp. 988–999.
- Howard, H., Levitt, R., Paulson, B., Pohl, J., and Tatum, C. (1989). Computer Integration: Reducing Fragmentation in AEC Industry. *Journal of Computing in Civil Engineering*, 3(1), pp. 18–32.
- Khosrowshahi, F., and Arayici, Y. (2012). Roadmap for implementation of BIM in the UK construction industry. *Engineering, Construction and Architectural Management*, 19(6), pp. 610–635.
- Kiprotich, C. *et al* (2014). An investigation on Building Information Modelling in Project Management: challenges, strategies and projects in the Gauteng Construction Industry, South Africa. WIREDSpace: Wits Institutional Repository environment on Dspace. Available at: <http://wiredspace.wits.ac.za/handle/10539/15492>
- Latham, M. (1994). *Constructing the Team* (Joint Review of Procurement and Contractual Arrangements in the United Kingdom Construction Industry).
- Lawrence, T. M., Watson, R. T., Boudreau, M.-C., Johnsen, K., Perry, J., and Ding, L. (2012). A new paradigm for the design and management of building systems. *Energy and Buildings*, 51(0), pp. 56–63.
- Linderoth, H. C. J. (2010). Understanding adoption and use of BIM as the creation of actor networks. *Automation in Construction*, 19(1), pp. 66–72.
- Migilinskas, D., Popov, V., Juocevicius, V., and Ustinovichius, L. (2013). The Benefits, Obstacles and Problems of Practical BIM Implementation. *Procedia Engineering*, 57, pp. 767–774.
- Miles, M. B., Huberman, A. M., and Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook*. SAGE Publications, Incorporated.
- Nawi, M. N. M., Lee, A., Azman, M. N. A., and Kamar, K. A. M. (2013). Fragmentation Issue in Malaysian Industrialised Building System (IBS) Projects. *Journal of Engineering Science and Technology*, 8(3), pp. 278–292.
- Porwal, A., and Hewage, K. N. (2013). Building Information Modeling (BIM) partnering framework for public construction projects. *Automation in Construction*, 31, 204–214.
- Rekola, M., Kojima, J., and Mäkeläinen, T. (2010). Towards Integrated Design and Delivery Solutions: Pinpointed Challenges of Process Change. *Architectural Engineering & Design Management*, 6(S1), pp. 264–278.

- Rowlinson, S., Collins, R., Tuuli, M., and Jia, Y. (2010). Implementation of Building Information Modeling (BIM) in Construction: A Comparative Case Study (pp. 572–577). Presented at the 2nd International ISCM Symposium and the 12th International EPMESC Conference, American Institute of Physics.
- Saunders, M., Lewis, P., and Thornhill, A. (2012). *Research Methods for Business Students*. Essex: Pearson.
- Sebastian, R. (2011). Changing Roles of the Clients, Architects and Contractors through BIM. *Engineering, Construction and Architectural Management*, 28(2), 176–187.
- Singh, V., Gu, N., and Wang, X. (2011). A theoretical framework of a BIM-based multi-disciplinary collaboration platform. *Automation in Construction*, 20(2), 134–144.
- Succar, B., Sher, W., and Williams, A. (2012). Measuring BIM performance: Five metrics. *Architectural Engineering & Design Management*, 8(2), pp. 120–142.
- Succar, B. (2009). Building information modelling framework: A research and delivery foundation for industry stakeholders. *Automation in Construction*, 18(3), pp. 357–375.
- Won, J., Lee, G., Dossick, C., and Messner, J. (2013). Where to focus for successful adoption of building information modeling within organization. *Journal of Construction Engineering and Management*, pp. 139(11), 04013014.
- Wong, A. K. D., Wong, F. K. W., and Nadeem, A. (2011). Government roles in implementing building information modelling systems. *Construction Innovation*, 11(1), pp. 61–76.

AN INVESTIGATION INTO SUPPLY CHAIN MANAGEMENT PROCESSES EFFICACY AND SERVICE DELIVERY ENHANCEMENT IN THE CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY

Soni, Manqoba Sinothile Mholi

ILOHM (Pty) Ltd, 21 Wild Current Street, Greenstone Hill, 1609, P.O. Box 7062, Greenstone, 1616

Kajimo-Shakantu, Kahilu

Department of Quantity Surveying and Construction Management, Univeristy of the Free State, Bloemfontein, South Africa

Abstract

There is a general lack of advance planning for Supply chain management (SCM) processes and the lengthy processes involved impact negatively on municipal construction projects. The study investigated stakeholder's perceptions of the improvement attempts being made in SCM processes for construction projects and service delivery in the City of Johannesburg (CoJ), South Africa. An empirical study using one municipality was undertaken through the administration of questionnaires. Key findings showed that respondents were of the view that SCM processes related functions are well defined, service delivery is not improving while the organisation encourages implementation of project management processes that are harmonised with its SCM processes. The study concludes that the SCM processes of the municipality under study are somewhat improving and current legislation has a positive effect. However, there is room for improvement to streamline the processes in order to reduce the bureaucracy which impacts negatively on the commencement and performance of construction projects. The study only involved one municipality therefore the sample size and geographical limitations may reduce the generalisability of the results. The study is relevant to various stakeholders as it enhances the understanding of how improved SCM processes can contribute to the overall performance of construction projects.

Keywords: Supply Chain Management, Service Delivery, Construction Project Management

1 Introduction

1.1 Problem identification

McCarthy (2006) claims that there is lack of capacity and limited knowledge about supply chain management processes in the public sector which affects the effectiveness and efficiency of procurement processes, leading to poor governance. Similarly, Luyt (2008) contends that poor planning and poor budgeting amongst government entities result in inadequate implementation of supply chain management processes. Amber & Badenhost-Weiss (2011) reported the following challenges; lack of knowledge, skills and capacity, non-compliance with supply chain policies and regulations, inadequate planning and poor linking of demand to the budget, accountability fraud and corruption, inadequate monitoring and evaluation of supply

chain management processes, unethical behaviour, over decentralisation of the procurement system and ineffective Black Economic Empowerment Policy.

There is generally a problem in terms of planning of projects as sometimes it happens that after planning City of Johannesburg (CoJ) officials find themselves having to execute projects that were not budgeted for due to pressure to deliver services to communities that are affected by non-availability of critical basic services (City of Johannesburg 2007). This often makes the planning process for projects redundant. Further, small and medium contractors are increasingly demanding to be appointed as sub-contractors on big projects even when they do not qualify therefore undermining the system and the Supply chain management (SCM) processes (City of Johannesburg 2007). Despite the availability of various legislations such as the Preferential Procurement Policy Framework (PPPF), Municipal Supply Chain Management Regulations and the Municipal Finance Management Act, the CoJ still has ineffective and long supply chain management processes for construction projects, as well as other challenges relating to service delivery enhancement.

1.2 Purpose and importance of the study

The purpose of the study is to investigate the SCM processes for construction projects in the CoJ and service delivery with the view to optimising SCM processes for construction projects and service delivery. The study also seeks to evaluate the quality of training and development provided by the CoJ on related SCM processes and service delivery procedures, policies, strategies and legislations. A further objective is to assess the effectiveness with which top management addresses procurement and service delivery related issues. This study will benefit not only the CoJ as an organisation through improving its SCM processes, but also the residents of Johannesburg through efficient delivery of construction projects and better municipal capital spend. Both the beneficiaries and small and medium enterprises will also benefit, as their construction projects will be finished on time without the fear of having contract price adjustments and penalties for late completion. This research project seeks to investigate the supply chain management process efficiency of construction projects and whether the CoJ is enhancing its service delivery to Johannesburg residents.

The outcome of the study will assist the CoJ to better manage construction projects in terms of time management within scope, quality and the allocated budget. It is hoped that some activities during the supply chain process would be done simultaneously in order to reduce the CoJ SCM bureaucratic processes, therefore ensuring the timely completion of construction projects.

2 Literature Review

2.1 Implementation of Supply Chain Management

European Union (2010) states that challenges in the public sector include the non-existence of follow up routines and effective reporting which impede strategic and methodical developments of a particular organisation in terms of its procurement management system applications. According to van der Waldt (2001), most spheres of government utilise project management to execute facility delivery programmes in the form of construction projects. Van Der Waldt (2001) asserts that while project and programme management is a tool-kit to improve facility delivery, by and large managers in the public sector do not know how to apply project management principles, i.e. they tend not to equip themselves through relevant courses. This is an indication that in order for the CoJ to succeed in improving their procurement systems it will have to harmonise project management and procurement systems. Therefore, the entire organisation and its systems, including procurement, should support projects' management in order for them to work effectively (Van der Waldt, 2007). The Project Management Capability Delivery Framework is one of the tools that is recommended to

manage projects successfully and therefore achieve service delivery in marginalised areas. It should also be noted that vision and strategy are part of what this framework can deliver (Marnewick, 2010). Lessons, failures and successes should be learned from previous projects in order to improve service delivery (Brown, 2005).

The CoJ currently uses the project life cycle model when implementing construction projects as illustrated in Figure 2.1, which assists in the planning process aimed at demonstrating how the projects' outcomes will be achieved successfully within the required timescale, scope, quality and the agreed budget. The project life cycle model is a useful way of understanding the different phases of a project as it progresses (Martin, 2008). The challenge is that this life cycle model is not harmonized with the procurement process in the CoJ which includes compiling of bids, advertising, closing of bids, bid evaluation as per PPPFA and recommendations, adjudication of bids and final award as well as compiling of service level agreements and contract documents. This implies that these two processes are utilized separately, and as a result projects are not finished on time due to delays (City of Johannesburg, 2007).

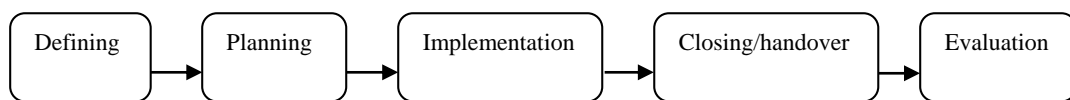


Figure 1. Project life-cycle model (Martin, 2008)

The above misalignment occurs between the defining and the planning stage when the built environment and engineering consultants are appointed, as well as during the planning and the implementation stage when the main contractor, sub-contractors and nominated contractors are appointed. Lastly supply chain management has become an important matter for some organisations to gain their competitive edge (Shi-Jie, Chen and Huang, 2007).

2.2 Service delivery theme

There are many public sector projects in South Africa which are not executed within the predetermined parameters of cost, time and quality and which also experience delayed payments (Baloyi and Bekker, 2011). An example of such is the construction of 104 housing units in Saulsville in Tswane (City of Tswane Municipality) with a cost of R85 million which were delivered with defective or poor quality (Mogomotsi, 2013). This reflects a waste of resources as well as poor service delivery to the intended beneficiaries. Public procurement in South Africa has since 1994, become an important tool to deliver wider social, economical and political objectives (Bolton, 2006). This is due to government's procurement capacity and its dual role as a regulator and purchaser. The way decisions are taken regarding with whom and how much to contract with has implications for various industry players and intended beneficiaries. Bolton (2006) argues that the leverage of the South African government to use procurement as a policy tool has encountered various challenges.

Russell and Bvuma (2001) explain that service delivery is a focal point on which the public service is most probably judged, especially in a country where service delivery benefits the poor communities. There are three key service delivery improvement initiatives in the country:

- Batho Pele;
- Public-private partnerships; and
- Alternative service delivery routes (Russell & Bvuma, 2001: 244-245).

In analysing the problem in conjunction with service delivery, officials at the CoJ are not motivated and their individual needs are not catered for, hence they are allegedly not seen to not be taking their work seriously and thus perpetuating poor service delivery. Employees in

the CoJ are often on strike and the communities, especially poor people, are frequently protesting. Abraham Maslow established a theory to illustrate the effects (i.e. individual needs) that motivate human behaviours (Robbins and DeCenzo, 2001: 314). Using Maslow's theory, it can be deduced that certain needs of officials of the CoJ need to be met for them to function well and for Johannesburg residents to receive quality services. This becomes evident when the executive management looks to increase salaries every year, as the South African Municipal Union (SAMU) rejects offers for salary increases and also highlights issues such as working conditions, health benefits, lack of tools, housing subsidies, car allowances, performance bonuses, favouritism, temporary/contract employment and unfair treatment by top management. Strikes have become a norm every year in the CoJ for all departments and Municipal Owned Entities (MoEs), while communities also protest about poor service delivery (City of Johannesburg, 2007). All these issues highlighted above affect the SCM processes.

3 Research Methodology

The empirical study used a case study approach using structured questionnaires to solicit respondents' views as indicated in Tables 1 and 2. The objective was to determine perceptions on the duration of the SCM processes, and the way construction projects are affected by the SCM bureaucratic processes including service delivery enhancement. Purposive sampling was used in the study. The sample was selected from the total population of CoJ employees who met the selection criteria, namely those that operated in certain departments and entities such as the Department of Environment, Infrastructure and Services; the Department of Development Planning and Urban Management; the Johannesburg Development Agency; Jo'burg Water; City Power; Pikitup; the Johannesburg Roads Agency, nine regions and the Department of Housing as indicated in Table 1.

Table 1. Size of the sample strata and response rate to the questionnaires

Departments and Entities	Proposed		Actual	
	No.	%	No.	%
Department of Infrastructure and Services	5	12.5	5	12.5
Department of Planning and Urban Management	5	12.5	5	12.5
Department of Housing	5	12.5	5	12.5
Department of Environment Management	5	12.5	5	12.5
City Power	5	12.5	5	12.5
Jo'burg Water	5	12.5	4	10
Johannesburg Development Agency	5	12.5	5	12.5
Pikitup	5	12.5	5	12.5
Total	40	100	39	97.5

The reason for this purposive sampling was that these entities, departments and regions deal with SCM in construction projects as well as service delivery related matters more often. Table 1, indicates that a high response rate of 97.5% was achieved. During the study, each department, entity and regional office was contacted telephonically so as to enquire who the appropriate Executive Director, Managing Director and Regional Directors to approach for permission to conduct a survey in their respective departments, entities and regions would be.

Table 2. Positions held by respondents in their representative organisations

Positions held by respondents in terms of management levels of operation (%)				
Senior management	Middle level management	Officer	Supervisor	Other
34.2	44.7	7.9	7.9	5.3

Table 2 shows that the majority of the respondents (78.9%) who implement construction projects using the SCM process operate at a senior management and middle management level and therefore are knowledgeable enough for the study. An introductory letter which outlined the purpose and objectives the study as well as request consent was sent to the respondents.

4 Findings and Discussion

Respondents were presented with statements related to procurement processes and infrastructure/service delivery by the CoJ, to which they needed to indicate the extent of their disagreement on a 5-point Likert scale where 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. The findings are ranked in terms of their mean scores (MSs) based on the percentage responses to the 5-point scale with 1.00 as a minimum value and 5.00 as a maximum value based on the percentage indicating the degree of concurrence of the statements (see Table 3 below). The Cronbach's alpha was used to determine the reliability or consistency of the measure. The Alpha coefficient ranges in value from 0 to 1 and was used to describe the reliability of factors extracted from dichotomous (questions with two possible answers) and/or multi-point formatted questionnaires or scales, e.g. rating scale: 1 = poor to 5 = excellent. Only the statements with an acceptable alpha value of more than 0.5 were used in this study. The values ranged from 0.5 to 0.90. The data were analysed using basic statistics as presented and discussed in the next section. The results are presented in Tables 3 and 4 below.

Table 3. SCM processes and service delivery

	Aspect	Response (%)					Mean Score
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
1.1	Your procurement SCM related functions are properly defined at the CoJ as an employee.	7.9	13.2	21.1	28.9	28.9	3.6
1.2	You are properly trained on SCM processes at the CoJ.	10.3	28.2	17.9	25.6	17.9	3.1
1.3	The CoJ is perceived to be delaying construction projects through inefficient SCM processes.	15.8	28.9	15.8	31.6	7.9	2.9
1.4	The CoJ is currently not improving SCM processes.	10.3	30.8	38.5	17.9	2.6	2.7
1.5	Despite the existing policies, programmes and legislation the CoJ is unable to implement its SCM processes.	25.6	30.8	35.9	5.1	2.6	2.3
1.6	Legislation has not negatively impacted on SCM processes.	20.5	25.6	20.5	30.8	2.6	2.7
1.7	You are properly trained on service delivery programmes of the CoJ.	2.6	20.5	15.4	35.9	25.6	3.6
1.8	The CoJ is perceived by Johannesburg residents to not be properly delivering services.	10.3	28.2	20.5	20.5	20.5	3.1
1.9	The CoJ is currently not improving on service delivery.	28.2	23.1	28.2	17.9	2.6	2.4
1.10	Despite the existing policies, programmes and legislation the CoJ is unable to deliver on its services effectively and efficiently.	20.5	28.2	10.3	30.8	10.3	2.8
1.11	Legislation has not positively impacted on service delivery.	5.1	35.9	17.9	38.5	2.6	3.0

Based on the Mean scores (MSs), the key findings are as summarised in Table 4.

Table 4. Training and top management involvement in SCM processes

	Aspect	Response (%)					Mean Score
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree	
1.1	Top management at CoJ monitors the various stages of currently existing SCM processes.	12.8	10.3	20.5	25.6	30.8	3.5
1.2	Top management at CoJ is involved in the process of evaluation and monitoring of SCM processes.	7.7	12.8	25.6	38.5	15.4	3.4
1.3	Officials are fully involved in the implementation of the SCM processes policies.	7.7	7.7	33.3	41.0	10.3	3.4
1.4	The CoJ offers training and education on SCM processes.	7.7	17.9	33.3	33.3	7.7	3.2
1.5	CoJ encourages the implementation of project management processes that are harmonised with its SCM processes.	5.1	20.5	23.1	38.5	12.5	3.3
1.6	Top management at CoJ monitors and evaluates service delivery.	2.6	17.9	12.8	48.7	17.9	3.6
1.7	The CoJ addresses clients' complaints within reasonable turn-around times on service delivery related issues.	17.9	20.5	28.2	20.5	12.8	2.9

The main findings of the study from the two tables are discussed further below.

4.1 Discussion of key findings

From Table 4.1, the items “top management in the organisation monitors and evaluates service delivery” scored the highest mean score of 3.6 followed by “top management at CoJ monitors the various stages of currently existing SCM processes” with a mean score of 3.4. These are encouraging results and put the organisation in better light. It was also found that CoJ encourages the implementation of project management processes that are harmonised with its SCM processes (mean score of 3.3). However, it emerged that “CoJ does not address client complaints within reasonable turn-around times on service delivery related issues” as it showed the lowest mean score of 2.9, undermining the image of the organisation. As Russell and Buvma (2001) indicated in the literature, service delivery is one important parameter on which the public sector is judged. From table 4.2, the following findings can be highlighted as: SCM processes related functions are properly defined in the organisation to employees (3.6 mean score highest mean score) and the organisation is currently not improving SCM processes (2.4 mean score second lowest). While the organisation under study is perceived as not properly delivering services or addressing client complaints within reasonable turn-around times on service delivery issues, the respondents were also of the view that “CoJ is improving its SCM processes and service delivery”. The results suggest that there is an effort to improve both SCM and service delivery.

The study also investigated respondents' perceptions on the training of employees in the organisation on SCM processes. A key finding was that; CoJ offers training and education on SCM processes (mean score of 3.4). They are also properly trained on the service delivery programmes of the CoJ (3.1). However, the results show that most of the respondents were not

formally trained in the Preferential Procurement Policy Framework Act as well as the Public Finance Management Act (PFMA), but were mostly trained in the Constitution of the Republic of South Africa, the Municipal Finance Management Act and the Local Government: Municipal Systems Act.

On the aspect of strategic leadership, respondents believe that SCM process-related functions are properly defined for them to perform their duties as this scored the highest mean score of 3.6. Results also show that top management monitors the various stages of currently existing SCM processes and is involved in the process of evaluation and monitoring of SCM processes. The results also show that top management at the CoJ monitors and evaluates service delivery and that it is relatively easy for top management to monitor and evaluate procurement and service delivery processes because most employees who deal with the SCM process of construction projects and service delivery operate at a middle management level. Top management is addressing the SCM and service delivery related issues. However despite the existing SCM policies, programmes and legislations available, the CoJ is unable to implement its SCM processes adequately as the results indicate the lowest mean score of 2.3.

5 Conclusions and Recommendations

The study sought to investigate the enhancement of SCM processes and service delivery by the CoJ by investigating top management involvement and formal training opportunities among others on SCM and service delivery policies. The study found that while top management seem to be involved in the implementation and monitoring of SCM and service delivery, the SCM processes are not fully optimised and the organisation is not able to handle client complaints within reasonable turn-around times particularly on service delivery related issues. The study concludes that the SCM processes of the municipality under study are somewhat improving and current legislation has a positive effect. However, there is potential for improvement to streamline the processes in order to reduce the bureaucracy which impacts negatively on the commencement and performance of construction projects. There is room for harmonisation of project management processes with SCM processes to enhance performance. Further studies on technical skills and relevant education should be conducted and there is also a need to explore reasons for the many service delivery protests and the failure to attend to complaints within the stipulated time lines. Studies in other municipalities should also be undertaken to determine if similar results will obtain.

6 References

- Abdullah, N.R., Aziz, A., Memon, A.H. & Rahman, I.A. 2013. Modelling Causes of Cost Overrun in Large Construction Projects with Partial Least Square-SEM Approach: Contractor's Perspective. *Research Journal of Applied Sciences, Engineering and Technology*. 5(6), pp.1963-1972.
- Amber, I.M. & Badenhost-Weiss, J. 2011. An Examination of Supply Chain Management in the South African Public Sector. *20th Annual IPSESA 2011 Conference*, 10-14 April Maastricht, the Netherlands
- Baloyi, L & Bekker, M. 2011. Causes of construction cost and time overruns: The 2010 FIFA World Cup stadia in South Africa. *Acta Structilia*, 18(1), pp. 52-67.
- Bolton, P. 2006. Government Procurement as a policy tool in South. *Journal of Procurement* 6(3), 193-217.
- Brown, C.J.B. & Botha, M.C. 2005. Lessons learnt on implementing project management in a functionally-only structured South African municipality. *South African Journal of Business Management*, 36(4), pp. 1-7.
- City of Johannesburg 2007. *City of Johannesburg Supply Chain Management Procedure Manual* Supply Chain Management Procedures eds, City of Johannesburg, Johannesburg,

Braamfontein.

- European Union. 2010. Risk Management in the Procurement of Innovation-Concepts and Empirical Evidence in the European Union. Research Policy. European Commission. pp. 124
- Luyt, D. 2008. Media and Advocacy Head of the Public Service Accountability Monitor (PSAM), at the Monitor (PSAM). Paper Presented at the United Nations Social Forum on 2 September 2008 in Geneva, Switzerland
- McCarthy, N.G. 2006. Report of the Auditor-General, Free State, Bloemfontein. 30 June 1-7
- Marnewick, C. L.L. 2010. A conceptual framework to improve the delivery capability of an organisation. *Acta Commercii*, 10, pp. 249-263.
- Martin, V. (ed) 2008, *Session 1-3, Block 4 Managing Projects and Change*, The Open University, Milton Keynes.
- Mogomotsi, M. 2013. *R85m wasted on building*. [Online]. South Africa: IOL. Available on: <http://www.iol.co.za/news/south-africa/gauteng/r85m-wasted-on-building-1.1507627#.VO8X9PmUd1Y> [Accessed 22 December 2015].
- Robbins, S. & DeCenzo, D. (eds) 2001, *Fundamentals of Management: Essential Concepts and Application (3rd ed.)*. Prentice-Hall, Upper Saddle River, New Jersey.
- Russel, E.,W. & Bvuma, D.,G. 2001. Alternative service delivery and public service transformation in South Africa. *International Journal of Public Sector Management*, 14(3), pp. 241-265.
- Shi-Jie, G., Chen, S. & Huang, E. 2007. A systematic approach for supply chain improvement using design structure matrix. *J Intell Manuf*, 18, pp. 285-299.
- Van der Waldt, G. 2007. Project management: a new service delivery paradigm: research article. *Koers: Bulletin for Christian Scholarship = Koers : Bulletin vir Christelike Wetenskap*, 72(2), pp. 239-260.
- Van der Waldt, G. 2001. Establishing a management by projects approach for service delivery. *Journal of Public Administration*, 36(4), pp. 296-311.

EVALUATING THE IMPACT OF PUBLIC SECTOR TARGETED PROCUREMENT STRATEGIES ON THE DEVELOPMENT OF SMEs IN THE CONSTRUCTION INDUSTRY

Adediran, Abdulrauf; Windapo, Abimbola Olukemi

Department of Construction Economics and Management, Faculty of Engineering and Built Environment, University of Cape Town, Rondebosch 7701, Cape Town, Western Cape, South Africa

Abstract

This paper examines the targeted procurement (TP) strategies of public sector clients such as state-owned enterprises (SOEs) in South Africa and whether these strategies impact on the development of SMEs in the construction industry. The rationale for this study stems from reports that while TP has been widely used as an instrument to improve the position of SMEs in the South African construction industry, three out of five SMEs do not become established firms. In addition, the nature of the impact of TP strategies on the growth performance of SMEs in the construction industry is not known. This stage of the study adopts a literature survey, mainly employing theoretical perspectives to establish the TP strategies used by public sector clients and the nature of its impact on SME development in the construction industry. Preliminary findings reveal that the TP strategies frequently used in the construction industry include unbundling, mandatory subcontracting, preferencing, third party management and incentives for KPIs and that TP strategies directly influence SME growth performance, however this relationship is mediated by the level of supply chain integration. It can be inferred from these findings that SOEs would need to carefully choose and implement the most appropriate TP strategy that enhances the integration between targeted SMEs and other entities in the supply chain.

Keywords: construction industry, procurement, SMEs, supply chain integration, targeted procurement

1 Introduction

Interacting with almost all spheres of human endeavour and having strong links with other sectors of the economy, the construction sector and its activities occupy a critical position that influences national strategic socio-economic development and improvement in the quality of life (Rwelamila, 2012; UNCHS, 1996). Government’s understanding of the construction industry’s significant role in the economy is well-documented in literature (London, 2008; Rwelamila, 2012; Shakantu, 2012). Implicitly, there has also been an increasing understanding of the need for the government to intervene in the construction industry that is largely dominated by albeit specialized, underperforming small and medium-sized enterprises (SMEs) (Egan, 1998; Latham, 1994; UK BIS, 2013; Wolstenholme, 2009).

SMEs have long been recognised to play an important role as key drivers of economic growth (Abor and Quartey, 2010; Shakantu, 2012; Vosloo, 1994). The South African architectural, engineering and construction (AEC) subsector, accounts for about 34.2% of total small business employment (Schüssler, 2012), making it the second largest employer among SMEs. Construction SMEs are very diverse and highly specialized; and they constitute a significant

part of the construction industry supply chain (Dainty et al., 2001). The sustained significance of construction small businesses has led to the focus of government's policies on promoting the advent of capable small contractors and supporting their continuous development and sustainability (Egan, 1998).

Consequently, some governments have implemented prescriptive measures to promote small contractor development (Gounden, 2000; Hawkins, 2012; Ofori, 1996; Watermeyer, 2003). Others have gone ahead to set-up and implement supportive procurement programmes (demand side interventions) and well-structured contractor development models (supply side interventions) (Dlungwana and Rwelamila, 2004). These interventions are usually implemented through public procurement where the government becomes an active participant in the market economy as a major client contributing significantly to GDP – up to 50% of entire domestic construction expenditure in South Africa (Ncwadi and Dangalazana, 2006). Therefore governments progressively use their purchasing power to intervene in the construction industry towards achieving a broad range of national socio-economic goals including the development and sustainability of the de facto drivers of economic growth, i.e. local SMEs.

Targeted procurement (TP) is an innovative government procurement intervention strategy designed to promote the participation of targeted enterprises and targeted labour in contracts (cidb, 2008a; Ofori, 2009; Watermeyer et al., 2001); in a bid to achieve the state entities' contractor development goals which are included as a relevant criterion for contract award, along with other functional criteria e.g. price and quality. While fewer studies have been undertaken to assess the impact of TP in South Africa, there have been more studies (e.g. Gounden, 2000; Kajimo-Shakantu, 2007; Letchmiah, 2012; Manchidi and Harmond, 2002) relating to preferential procurement policy generally. Previous reports (Letchmiah, 2012; Manchidi and Harmond, 2002) indicate that TP have successfully opened up the construction industry to SMEs with their contract-winning rate and market share increasing significantly; however, SMEs remain deprived in a competitive industry where three out of five SMEs do not become established firms (Greyling, 2012; Mofokeng and Thwala, 2012).

The TP process in the construction industry is made-up of a network of supply chain relationships between targeted SMEs and other entities in the project supply chain. Manchidi and Harmond (2002) highlight the difficulty of targeted enterprises to form genuine quality contracting relationships (or integration) with other entities in the supply chain, which limit their ability to develop organizational and operational capacities (Kajimo-Shakantu, 2007). This paper therefore examines the TP process of public sector clients, specifically state-owned enterprises (SOEs) in South Africa using a literature survey, to identify the prevalent TP strategies used when targeting SMEs in the construction industry, and whether the quality of relationships formed with other entities in the TP process interacts with the TP strategies implemented to influence the growth performance (or development) of SMEs.

2 Overview of targeted procurement strategies, supply chain relationships and measures of SME growth performance

The phenomenon being investigated by this study (i.e. the relationship between TP and SME development), has its theoretical underpinnings in the field of industrial organisation economics. Industrial organisation economics builds on the theory of the firm, which is a group of economic theories that explain and predict the nature of the firms – existence, behaviour, structural organisation, and their relationship to the market or industry as a whole. However industrial organisation economics focuses on two main areas, i.e. the structural and behavioural characteristics of the industry, and how these influences the performance of firms in the industry (Bain, 1959; Martin, 1993). Two schools of thought exist in the field of industrial

organisation economics, namely: the Chicago School and the Structure-Conduct-Performance (SCP).

The Chicago School argues for economic rationalism, i.e. market forces rather than government intervention should dictate the allocation of economic resources and determine the performance of firms within the industry (Stilwell, 1993). This approach is usually applied to markets in perfect competition, which is not always the case, as some experience market failure or severe socio-economic challenges e.g. income inequality in South Africa (Palma, 2005; Rwelamila, 2012; UNDP, 2013). While the SCP school of thought argues for government intervention. The rationale is that because market structure has a direct influence on, and is central to the firm's economic conduct/behaviour, which in turn affects the firm's performance in the market, it is necessary for governments in their role as the regulator of the economy, to intervene in altering the market structure towards influencing the growth performance firms and the market as a whole (Bain, 1959). Targeted procurement – a form of government intervention, adheres to the SCP paradigm, and evidence (Kajimo-Shakantu, 2007; Letchmiah, 2012) shows that TP has changed the structural characteristics of the construction industry with the market share of SMEs increasing significantly.

2.1 Targeted procurement strategies

The ADB (2012) reveals that SME development procurement initiatives are most often applied by governments in two broad ways: bid price preferences that load the lowest non-SME bid or provide a discount to the lowest SME bid, and set-asides which provide quotas for targeted SMEs to bid competitively against each other. For example, in Singapore, bidding preferences were offered to local construction firms and joint ventures (Ofori, 1996). While, Botswana implemented bid preferencing schemes to promote engagement of citizen contractors (Watermeyer, 2003). On the other hand, set-asides or reserved procurement strategies have been used to encourage participation of small businesses and minority business enterprises in government contracts in the US, South Africa, Indonesia and Malaysia (Arrowsmith, 1995; Hawkins, 2012) and to develop minority enterprise and counter the effects of past discrimination (Bolton, 2006; Chatterji et al., 2014).

Preferential procurement practices in public procurement are an important government intervention strategy for stimulating the growth and development of SMEs in the construction industry of many countries including South Africa (Hawkins, 2012; Watermeyer et al., 2001). The adoption of preferential procurement policies in South Africa as a vehicle for contractor development, in a practice called targeted procurement is well documented in literature (London, 2008; Shakantu, 2012; Watermeyer, 2003). As part of national procurement reforms to address past imbalances and stimulate SME growth and development, the Department of Public Works, in 1996, introduced innovative TP strategies to promote the participation of targeted SMEs in public sector contracts (Shakantu, 2012).

The various public sector TP strategies used in public procurement include (cidb, 2008b; Letchmiah, 2012; Watermeyer, 2005):

- Unbundling of Contracts – where contracts are broken down into smaller contracts or packages to facilitate the participation of SMEs and/or emerging contractors in procurement as main or prime contractors;
- Mandatory Subcontracting – where larger main contractors are required to subcontract a portion of the works to SME contractors using client-prescribed procurement procedures;
- Preferencing – where tender evaluation points are granted to those contractors who satisfy prescribed preferencing criteria (such as joint ventures between large and SME contractors);

- Third Party Management – where larger established contractors and/or consultants are required to provide construction management support, and mentor SMEs and/or emerging contractors in the execution of contracts as prime contractors and monitor satisfactory progress of their work; and
- Incentives for KPIs – where a specified target (key performance indicator) has been set, contractors who achieve the KPIs are awarded incentive payments. Public sector clients tend to combine some of the identified TP strategies in an effort to maximize outcomes.

2.2 Supply chain relationships and review of existing models

Construction industry projects are often characterized by a highly fragmented supply chain and a less fragmented demand side that is organized and linked via supply chain relationships (Oyegoke et al., 2009). The supply chain management concept aims to integrate the interests of all stakeholders (suppliers and customers) towards the common goal of efficiently delivering best value to the client (Brown et al., 2001; Cox and Townsend, 1998; Oyegoke et al., 2009). According to Pryke (2006), the construction project can be viewed as a network of relationships between firms that make up the project supply chain.

Emerging in the purchasing and supply sector in the mid-1990s, supply chain relationship models has subsequently been introduced in the construction industry to describe, measure and improve the relationships between the key partners of a construction supply chain. Seven existing models that describes the change in supply chain relationships from the traditional to the collaborative have been identified in this paper. They include: the client-contractor working relationship model (Larson, 1995), the model of partnering (Ellison and Miller, 1995), the Construction Industry Institute's (CII) partnering continuum (Thompson and Sanders, 1998), the Best Practice in Partnering Group's (BPiPG) partnering positioning matrix (Jones and O'Brien, 2003), the Strategic Forum for Construction's (SFfC) supply chain maturity assessment grid (SFfC, 2003), the supply chain position matrix (Hines, 1994), and the supply chain relationship maturity model by Meng et al. (2011).

Six of the models are all related to the construction industry, while Hine's supply chain position matrix is a comprehensive model developed in the purchasing and supply sector that provides a good comparison with construction specific models. Three of the construction-oriented models focus on the relationships between clients and main contractors, and have not paid attention to downstream relationships where majority of SMEs in the construction industry are clustered. With the exception of Meng et al.'s supply chain relationship maturity model, the other three models that try to examine the supply chain as a whole have limited use in practice as they are only applicable to integrated supply chains, which makes them difficult to use when different types of relationships exist in different parts/tiers of the supply chain such as the construction industry. Most of the existing models are further characterised by either inappropriate definition of relationship levels, or biased towards the collaborative end of the supply chain relationship spectrum by establishing one level for a traditional relationship and three levels for different partnering (Meng, 2010). However evidence shows that most supply chains in the construction industry are still very traditional, as partnering is yet to be fully entrenched in construction practice (Briscoe and Dainty, 2005; Meng et al., 2011).

In comparison, Meng et al.'s supply chain relationship maturity model builds on the inherent weaknesses of the other models such as incomplete coverage of key criteria, and develops a robust systematic model that explores the special characteristics of the construction industry supply chain. Developed in the UK construction industry, the model adopts the capability maturity approach (Paulk et al., 1993), and establishes four construction supply chain relationship maturity levels in matrix format with 24 assessment criteria in eight categories at each of the four maturity levels. This model will be adapted to reflect supply chain relationships

in the context of the South African construction industry. The adopted supply chain relationship maturity model focuses on specific relationships between customer and supplier rather than the whole supply chain. This will allow for a robust understanding of the quality of relationship between targeted SMEs and other key partners of the construction supply chain.

The key component of the model that sum up the quality of supply chain relationships are the four maturity levels which describes the progression of relationship improvement from adversarial, through limited cooperation and short-term collaboration, to close and long-term collaboration. They are: Price competition (Level 1), Quality competition (Level 2), Project partnering (Level 3), and Strategic partnering (Level 4). The supply chain relationship at Level 1 is characterized by self-interest, mistrust, lack of mutual objectives, and win-lose business philosophy that results in adversarial or arms-length relationships. Level 2 is characterized by partial win-win benefits, and trust is mainly built on the capability of each party to execute quality work; this is regarded as a transition from traditional to collaborative relationship. At Level 3, mutual objectives are achieved on a single project, partners work together collaboratively as an integrated project team, goodwill trust and win-win attitude fosters the project partnering relationship. At Level 4, objectives are aligned over a series of projects, close collaboration is achieved across the whole supply chain, high degree of trust exist between partners, and an attitude of performance measurement and continuous improvement is adopted.

2.3 Measures of SME growth performance

Small firm growth theorists (Davidsson et al., 2005; Penrose, 1959; Starbuck, 1971) refer to growth as the change in an organization's size – a multidimensional phenomenon that necessarily happens over time. Unlike large firms that tend to grow through acquisitions, small firms usually grow organically (Penrose, 1959). In the analysis of firm growth from the change-in-size perspective, growth has been measured with a range of different indicators in the literature; the most frequently suggested being sales, revenue, employment, assets, physical output, market share and profits (Ardishvili et al., 1998; Delmar, 1997; Weinzimmer et al., 1998; Wiklund, 1998). In specific industry studies, more specialized measures are conceivable (Davidsson et al., 2005). For example, in construction, increase in turnover and employment are the most frequently used by scholars in construction management research (Abu Bakar et al., 2011, 2012; Ofori and Chan, 2000; Tucker et al., 2015). However, in the context of this study, multiple indicators of increase in turnover, assets (plants and equipment), and number of permanent and skilled employees will be used to measure SME growth performance (development) in relation to targeted procurement objectives. These indicators are selected because the South African Construction Industry Development Board (cidb) uses increase in financial and works capability plus number of registered skilled professionals in a firm's employment as the main requirements for progressing through the cidb contractor grading system – a holistic measure of company growth and development in the South African construction industry.

3 The impact of Targeted Procurement strategies on SME development

According to Chatterji et al. (2014) and Letchmiah (2012), little is known about the actual effectiveness of preferential procurement in promoting the growth and development of SMEs, and only a handful of studies have attempted to analyse whether these programmes have met their goals in the construction industry. Reports from previous studies on the impact of set-asides in the US construction industry indicate that set-asides: significantly increased contract awards to SMEs (Marion, 2007); have a positive and significant empirical impact on SME growth regardless of how growth is measured (House-soremekun, 2006); and plays a significant role in the net survival rates of these SMEs (Marion, 2007). However, Blanchflower

and Wainwright (2005) argue that these programmes have not achieved their objective of improving the position of SMEs in the construction industry.

In South Africa, four major previous studies (Gounden, 2000; Kajimo-Shakantu, 2007; Letchmiah, 2012; Manchidi and Harmond, 2002) have been identified in literature. Three key similarities can be drawn from the results of these independent studies – the application of TP strategies significantly contributed to increased participation of SMEs in government tendering process, led to greater success in winning government contracts, and promoted the development of business linkages between historically empowered firms and historically disadvantaged SMEs. However, attempts to measure the impact of TP on individual SME growth performance in the construction industry has been evasive so far. Furthermore, it is unknown, how and whether, the quality of relationship interacts with the implemented TP strategies to influence the growth performance of SMEs.

4 Conceptual framework

This study draws on the theories of industrial organization economics, strategic management and supply chain management (Davidsson et al., 2005; London, 2008; Martin, 1993). Based on literature review, a conceptual model is developed showing that there is a relationship between targeted procurement strategies, supply chain integration and the development of SMEs through the procurement process (see Figure 1) (Quality of relationships and supply chain integration are used interchangeably in this paper). The constructs for SME development are turnover, assets (plants and equipment) and number of skilled employees (Abu Bakar et al., 2011, 2012; Ofori and Chan, 2000; Teruel-Carrizosa, 2006; Tucker et al., 2015). Quality of supply chain relationships/integration are price competition (Level 1), quality competition (Level 2), project partnering (Level 3), and strategic partnering (Level 4) (Meng et al., 2011). While TP strategies identified are unbundling, mandatory subcontracting, preferencing, third-party management, and incentives for KPIs (cidb, 2008b; Letchmiah, 2012; Watermeyer, 2005).



Figure 1. Conceptual framework

The conceptual model proposes that there is a direct linear relationship between TP strategies (independent variable) and SME development (the primary variable, which is also the dependent variable); while quality of supply chain relationships (moderating variable) mediates the relationship between TP strategies and SME development. However it is not known, how and whether, the quality of supply chain relationships/integration interacts with the implemented TP strategies to influence the growth performance of SMEs. Thus further

empirical research is required to determine how TP strategies and corresponding relationships impact on the development of SMEs in the construction industry. The relationships among targeted procurement strategies, quality of relationship, and SME development are also modelled using linear (Equations 1, 2, and 3) and multiple regressions (Equation 4).

$$Y (\text{SME Development}) = X (\text{Targeted Procurement Strategies}) \dots\dots\dots 1$$

$$Y (\text{SME Development}) = X (\text{Quality of Relationships}) \dots\dots\dots 2$$

$$Y (\text{Quality of Relationships}) = X (\text{Targeted Procurement Strategies}) \dots\dots\dots 3$$

$$Y (\text{SME Development}) = X1 (\text{Targeted Procurement Strategies}) + X2 (\text{Quality of Relationships}) \dots\dots 4$$

In both equation 1 and 2, SME development is the dependent variable while TP strategies and quality of relationships is the independent variable respectively. This implies that SME growth performance changes depending on the TP strategy used, and the level of supply chain integration. In equation 3, quality of relationships is the dependent variable while TP strategies is the independent variable meaning the level of supply chain integration changes depending on the TP strategy used. Because SME development is a dependent variable to both TP strategies and quality of relationships in equations 1 and 2 respectively, it suggests that TP strategies interact with quality of relationships within the supply chain entities to influence SME growth performance. Hence, SME development becomes a function of this interaction as shown in equation 4, where SME development is the dependent variable and TP strategies and quality of relationships/integration between the supply chain entities are independent variables.

5 Conclusion and further research

The study examines the TP strategies of public sector clients such as state-owned enterprises (SOEs) in South Africa and whether these strategies impact on the development of SMEs in the construction industry using theoretical perspectives. The literature survey conducted established that the targeted procurement strategies used in the construction industry include unbundling, mandatory subcontracting, preferencing, third party management and incentives for KPIs and that TP strategies directly influence SME growth performance, however this relationship is mediated by the level of supply chain integration. Further empirical research is required to measure the impact of TP on individual SME growth performance in the construction industry and to determine the type of contracting relationships formed by SMEs with other entities in the supply chain and whether this impacts on their growth and performance.

The proposed further research is to be conducted in South Africa, because the South African construction industry possesses all the legal and structural underpinnings for the proposed investigation. The study will follow a three-stage sequential triangulated mixed-method approach – emphasizing qualitative techniques, but also combining quantitative methods to enrich answers to the research questions. Through deep and robust narratives, qualitative data will provide analytical insights that will help in understanding the quality of relationships that develop in the project delivery process, while quantitative data will provide measurable indicators of outcomes to improve generalizability and transferability of research findings.

The unit of analysis for this study will be the TP projects of identified SOEs such as South African National Roads Agency Limited (SANRAL), Airports Company South Africa (ACSA), Passenger Rail Agency of South Africa (PRASA), Petroleum Oil and Gas Corporation of South Africa (PetroSA). Respondents will be selected from supply chains of SOEs that have developed in response to a TP project. Primary focus will be on the construction cluster in the supply chain, thus excluding the design cluster. Selected respondents will be limited to cidb Grade 3 – 6 contractors that have executed TP projects within the last 5 years. Grade 1 to 2 contractors are excluded because they are unlikely to reflect the growth performance been sought, while Grade 7 to 9 contractors are excluded because these are

considered established contractors. Finally, collected research data will be analysed via statistical categorical data analysis, and interpreted in both qualitative and quantitative manner. Outcomes of this study will include an empirically tested and validated model that proposes a strategy for selecting and implementing the most appropriate TP strategy that enhances the quality of relationship formed between targeted SMEs and other entities in the supply chain. The study will also contribute to the body of knowledge in strategic construction management research that helps decision-makers, researchers and policy makers in better understanding the role of procurement regimes in stimulating the growth and development of SMEs in the construction industry, and will also enable organs of state to better measure their procurement policy objectives against intended outcomes.

6 Acknowledgement

The funding from the University of Cape Town towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the authors and are not necessarily to be attributed to the University of Cape Town.

7 References

- Abor, J., & Quartey, P. (2010). Issues in SME Development in Ghana and South Africa. *International Research Journal of Finance and Economics*, 39(39), 218–228.
- Abu Bakar, A. H., Abdul Razak, A., Yusof, M. N., & Abdul Karim, N. (2011). Factors determining growth of companies: A study on construction companies in Malaysia. *African Journal of Business Management*, (5), 8753–8762.
- Abu Bakar, A. H., Tabassi, A. A., Abd. Razak, A., & Yusof, M. N. (2012). Key factors contributing to growth of construction companies: A Malaysian experience. *World Applied Sciences Journal*, 19(9), 1295–1304.
- ADB. (2012). *SME Development: Government Procurement and Inclusive Growth*.
- Ardishvili, A., Cardozo, S., Harmon, S., & Vadakath, S. (1998). Towards a theory of new venture growth. In *Babson Entrepreneurship Research Conference*. Ghent, Belgium.
- Arrowsmith, S. (1995). Public procurement as an instrument of policy and the impact of market liberalisation. *Law Quarterly Review*, (111), 235–284.
- Bain, J. S. (1959). *Industrial Organization*. New York: John Wiley & Sons, Inc.
- Bolton, P. (2006). Government procurement as a policy tool in South Africa. *Journal of Public Procurement*, 6(3), 193–217.
- Briscoe, G. H., & Dainty, A. R. J. (2005). Construction supply chain integration: an elusive goal? *Supply Chain Management: An International Journal*, 10(4), 319–326.
- Brown, D., Ashleigh, M., Riley, M., & Shaw, R. (2001). New project procurement process. *Journal of Management in Engineering*, 7(4), 192–201.
- Chatterji, A. K., Chay, K. Y., & Fairlie, R. W. (2014). The Impact of City Contracting Set-Asides on Black Self-Employment and Employment. *Journal of Labor Economics*, 32(33), 507–561.
- cidb. (2008a). *Inform practice Note #10: Attaining social and economic deliverable*. Construction Industry Development Board.
- cidb. (2008b). *Inform Practice Note # 4: Procuring Best Value in Construction Works* (2nd ed.). Construction Industry Development Board.
- Cox, A., & Townsend, M. (1998). *Strategic procurement in construction: Towards better practice in the management of construction supply chains*. Lincolnshire: Thomas Telford Publishing.
- Dainty, A. R. J., Millett, S. J., & Briscoe, G. H. (2001). New perspectives on construction supply chain integration. *Supply Chain Management: An International Journal*, 6(4), 163–173.

- Davidsson, P., Achtenhagen, L., & Naldi, L. (2005). Research on small firm growth: A review. *European Institute of Small Business*, 1–27.
- Delmar, F. (1997). Measuring growth: Methodological considerations and empirical results. In R. Donckels & A. Miettinen (Eds.), *Entrepreneurship and SME Research: On its Way to the Next Millennium* (pp. 190–216). Aldershot, UK and Brookfield, VA: Ashgate.
- Dlungwana, W. S., & Rwelamila, P. D. (2004). Contractor Development Models That Meet the Challenges of Globalisation - A Case for Developing Management Capability of Local Contractors. In *CIB 2004 International Symposium on Globalisation and Construction* (pp. 1–12). Bangkok, Thailand.
- Egan, J. (1998). *Rethinking Construction: The Report of the Construction Task Force*. London: Department of the Environment, Transport and the Regions.
- Ellison, S. D., & Miller, D. W. (1995). Beyond ADR: Working Toward Synergistic Strategic Partnership. *Journal of Management in Engineering*, 11(6), 44–54.
- Gounden, S. (2000). *The impact of the national department of public works' affirmative procurement policy on the participation and growth of affirmable business enterprises in the South African construction sector*. Unpublished PhD Thesis, University of Natal.
- Greyling, E. (2012). *South Africa SME Observatory: Opportunities for Employment Creation through SME Development in the construction sector, Free State*. South Africa: International Labour Organization.
- Hawkins, J. (2012). Promoting social opportunities in the procurement of construction projects. In G. Ofori (Ed.), *Contemporary Issues in Construction in Developing Countries* (pp. 61–82). Oxon: Spon Press.
- Hines, P. (1994). *Creating World Class Suppliers: Unlocking Mutual Competitive Advantage*. London: Pitman Publishing.
- Holland, J., & Ruedin, L. (2012). Monitoring and evaluating empowerment processes. In *Poverty Reduction and Pro-Poor Growth: The Role of Empowerment*. OECD.
- House-soremekun, B. (2006). The impact of minority set-aside programs on black business success in Cleveland, Ohio: Implications for public policy. *Western New England Law Review*, 30(19), 19–38.
- Jones, M., & O'Brien, V. (2003). *Best Practice Partnering in Social Housing Development*. Thomas Telford Limited.
- Kajimo-Shakantu, K. (2007). *An Investigation into the Responses of the Construction Industry to Preferential Procurement in South Africa*. Unpublished PhD Thesis, University of Cape Town.
- Larson, E. (1995). Project Partnering: Results of Study of 280 Construction Projects. *Journal of Management in Engineering*, 11(2), 30–35.
- Latham, M. (1994). *Constructing the Team*. London: HMSO.
- Letchmiah, D. R. (2012). *An Examination of the effectiveness of Preferential Procurement in the South African Construction Industry*. Unpublished PhD Thesis, University of the Witwatersrand.
- London, K. (2008). *Construction Supply Chain Economics (Spon Research)*. Oxon: Taylor & Francis.
- Manchidi, T. E., & Harmond, I. (2002). *Targeted Procurement in the Republic of South Africa: An Independent Assessment*. Department of Public Works Republic of South Africa.
- Marion, J. (2007). The Effectiveness of Affirmative Action in Highway Procurement. In *Impact 209 Conference UCLA*. Los Angeles.
- Martin, S. (1993). *Industrial Economics: Economic Analysis and Public Policy*. NJ: Prentice Hall.
- Meng, X. (2010). Assessment framework for construction supply chain relationships:

- Development and evaluation. *International Journal of Project Management*, 28(7), 695–707.
- Meng, X., Sun, M., & Jones, M. (2011). Maturity Model for Supply Chain Relationships in Construction. *Journal of Management in Engineering*, 27(2), 97–105.
- Mofokeng, G., & Thwala, W. D. (2012). Mentorship Programmes within the Small and Medium Sized Contractor Development Programme : A Case Study of the Free State Province , South Africa. *Journal of Economics and Behavioral Studies*, 4(12), 712–722.
- Ncwadi, M. R., & Dangalazana, T. (2006). An Analysis of the Challenges Facing Emerging Contractors in the Nelson Mandela Metropole, South Africa. *Africa Insight*, 36(3), 186–198.
- Ofori, G. (1996). International contractors and structural changes in host country construction industries: case of Singapore. *Engineering, Construction and Architectural Management*, 3(4), 271–288.
- Ofori, G. (2009). Construction SMME development. *Isiza*, 6.
- Ofori, G., & Chan, S. L. (2000). Growth Paths of Construction Enterprises in Singapore. *Engineering, Construction and Architectural Management*, 7(3), 307–321.
- Oyegoke, A. S., Dickinson, M., Khalfan, M., McDermott, P., & Rowlinson, S. (2009). Construction project procurement routes: an in-depth critique. *International Journal of Managing Projects in Business*, 2(3), 338–354.
- Palma, G. (2005). Four sources of “de-industrialization” and a new concept of the “Dutch disease.” In J. A. Ocampo (Ed.), *Beyond Reform: Structural Dynamics and Macroeconomic Vulnerability*. Stanford: Stanford University Press.
- Paulk, M. C., Curtis, B., Chrissis, M. B., & Weber, C. V. (1993). *Capability maturity model for software, Version 1.1*. Pittsburgh: Software Engineering Institute, Carnegie Mellon University.
- Penrose, E. (1959). *The Theory of the Growth of the Firm*. Oxford: Oxford University Press.
- Pryke, S. (2006). Projects as networks of relationships. In S. Pryke & H. Smyth (Eds.), *Management of Complex Projects: A Relationship Approach*. Oxford: Blackwell Publishing.
- Rwelamila, P. D. (2012). Construction project performance in developing countries. In G. Ofori (Ed.), *Contemporary Issues in Construction in Developing Countries* (pp. 318–346). Oxon: Spon Press.
- Schüssler, M. (2012). *The 11th UASA employment report. South Africa cannot afford South Africans*. Gauteng, South Africa.
- SFFC. (2003). Supply chain maturity assessment grid. Strategic Forum for Construction.
- Shakantu, W. M. (2012). Contractor development. In G. Ofori (Ed.), *New Perspectives on Construction in Developing Countries* (pp. 253–281). Oxon: Spon Press.
- Starbuck, W. H. (1971). Organizational growth and development. In W. H. Starbuck (Ed.), *Organizational growth and development: Selected readings*. Victoria, Australia: Penguin Books.
- Stilwell, F. (1993). Economic rationalism: sound foundations for policy? In S. Rees, G. Rodley, & F. Stilwell (Eds.), *Beyond the Market: Alternatives to Economic Rationalism* (pp. 27–37). Leichardt: Pluto Press.
- Teruel-Carrizosa, M. (2006). *Firm growth, persistence and multiplicity of equilibria: An analysis of spanish manufacturing and service industries*. PhD thesis, Universitat Rovira i Virgili.
- Thompson, P. J., & Sanders, S. R. (1998). Partnering Continuum. *Journal of Management in Engineering*, 14(5), 73–78.
- Tucker, G. C., Windapo, A. O., & Cattell, K. S. (2015). Exploring the use of financial capacity as a predictor of construction company corporate performance: evidence from

- South Africa, *Journal of Engineering, Design and Technology*, 13(4) 596-611.
- UK BIS. (2013). *Construction 2025 Industry Strategy: Government and industry in partnership*. London, UK: Department for Business, Innovation & Skills.
- UNCHS. (1996). *Policies and Measures for Small-Contractor Development in the Construction Industry*. Nairobi: HABITAT.
- UNDP. (2013). *Humanity Divided: Confronting Inequality in Developing Countries*. NY: UNDP.
- Vosloo, W. B. (1994). The small firm as a vehicle for entrepreneurship. In W. B. Vosloo (Ed.), *Entrepreneurship and Economic Growth*. Pretoria: HSRC.
- Watermeyer, R. B. (2003). Implementing preferential procurement policies in the public sector in South Africa. *Journal of the South African Institution of Civil Engineering*, 45(3), 11–22.
- Watermeyer, R. B. (2005). A generic and systemic approach to procurement : the case for an international standard. *Public Procurement Law Review*, (1), 39–61.
- Watermeyer, R. B., Jacquet, A., & Noyana, C. (2001). Developing the Capacity of Targeted Enterprises in Contractor Development Programmes. In *Regional conference on Developing the Construction Industries of Southern Africa*. Pretoria.
- Weinzimmer, L. G., Nystrom, P. C., & Freeman, S. J. (1998). Measuring organizational growth: Issues, consequences and guidelines. *Journal of Management*, 24(2), 235–262.
- Wiklund, J. (1998). *Small Firm Growth and Performance: Entrepreneurship and Beyond*. PhD Thesis, Jönköping International Business School.
- Wolstenholme, A. (2009). *Never waste a good crisis: A review of Progress since Rethinking Construction and Thoughts for Our Future*. London: Constructing Excellence in the Built Environment.

Emerging Trends in Organizational Practices and Procedures in Construction

THE USE OF SOCIAL MEDIA IN REAL ESTATE TRANSACTIONS IN LAGOS, NIGERIA

Babatunde, Theophilus Olugbenga; Ajayi, Cyril Ayodele; Timothy Tunde Oladokun
*Department of Estate Management, Faculty of Environmental Design and Management, Obafemi
Awolowo University, Ile-Ife, Osun State, Nigeria*

Abstract

Real estate business is an information- driven business where valuable information is shared and evaluated between buyer and seller, and/or tenant and landlord before concluding a transaction through an agent who serves as an intermediary between them in the localized property market. Where information is inadequate, successful transactions in the market may be impeded. With the introduction of ICT, social media in particular, it appears that this problem has reduced. This study therefore evaluated the level of use and the challenges faced in the use of social media for sharing information by real estate practitioners in Lagos, Nigeria. Data were collected with the use of questionnaire administered on 220 Estate surveying firms in Lagos, Nigeria with a response rate of 84%. The data collected were analyzed using frequency distribution, percentage and mean ranking. The results showed that virtually all estate practitioners made use of social media in real estate business transactions. E-mail was the most preferred medium, followed by used phone calls and Facebook. Property websites and bulk SMS were also been used. The least used social media include YouTube; blog, and LinkedIn. The highest ranked challenge in the use of ICT was service failure, followed by power failure and service cost respectively. The study concluded that while vast majority of the real estate practitioners in Lagos were using ICT social media in business transactions, there were limitations in the usage due to some challenges.

Keywords: Information, Information Technology, Property market, Real Estate Transactions, Social media

1 Introduction and Background to the Study

Technological advancement, no doubt, has greatly influenced the survival of man in all ramifications. The impact appears so enormous on some areas of life such as construction, manufacturing, finance and communication, amongst others. Communication on the other hand seems to have affected the way and manner people share information and interact on daily basis in the society as well as business transactions/relationships such as real estate agency. Real estate business is seen to be an information based business where the prospect of an agent appears to be hinged on how well and accessible the information are made available.

The emergence of ICT had greatly influenced business activities of real estate agents (Raouri 2011). According to the author real estate is an information intensive business which is inherently amenable to application of information and communication technology tools and services such as the internet, World Wide Web (www) and global system mobile phone which have provided impetus to the real estate industry.

In Nigeria, the real estate industry can be said to be an attraction to investors. With the global financial meltdown as well as the collapse of the capital market, local and foreign investors can be said to have resorted to investing in real estate which is said to have better hedge against inflation. Also, the recent liberalization policies of the government and emphasis on foreign direct investment both local and foreign investors could be willing to secure their fund in an asset that constantly appreciate in value.

However, the erstwhile real estate attribute of fixity and localised can be said to have been eroded by recent explosion of ICT. The property market anywhere, is open to participation from any part of the world, because the social media has the tendency to connect buyers and sellers together for real estate transactions. Therefore, the question of, to what extent the social media has been used to ease real estate transactions in a developing country like Nigeria will interest foreign investors who is contemplating investing in the Nigerian property market.

Previous studies such as Buxmann and Gebauer (1998); Muhanna (2000); Rowley (2005); McDonagh (2006) and Razali, Manf and Yassin (2010) have concentrated on the use of ICT, web, and internet facilities in the real estate industry with little or no emphasis on social media (which among others include Facebook, email, Blogs LinkedIn Twitter and WhatsApp) provided on the platform of internet. The evolution of internet and web facilities provided a platform for social media technology which provided opportunities to develop new relationships, create awareness and enhance competitive advantage.

Consequently, there appears to be easy flow of information on the social media which may be optimised by using the platform for real estate business. It is in view of this that this study seeks to determine the extent to which social media (such as Facebook, LinkedIn, Twitter, Blogs etc.) are being used in real estate transactions (agency) and the challenges being faced in the course of using the social media in practice.

2 Literature Review

The emergence and development of ICT and most especially internet facility, have captivated scholars to carry out a number of studies on its impact on real estate agency. Studies conducted in the past which are relevant to this paper exist in the developed world as well as developing nations. These studies however have either addressed the impact of ICT and internet facilities on real estate agency without linking it to Social Media such as Facebook, LinkedIn, Twitter, etc. which are platforms (interface) provided by internet facility.

For instance, Roulac (1996) studied strategic implications of information technology for the real estate sector in the United State of America. The study showed that the role of information technology in real estate started with the computer which is being used for various purposes ranging from data storage, iterative process of calculating internal rate of return, exploration of sensitivity analysis and probabilistic simulation, portfolio monitoring and management, property analysis and valuation, automation of residential appraisal process through integrated GIS data systems and lastly, in the screening and selection of properties in the housing realm by expanding access to information on the market generally. The study concluded that information technology introduced complexity and simplicity to real estate sector by streamlining transactions via securitization, and enabled more sophisticated and readily accessible property analysis and loan processing.

In a similar manner, Buxmann and Gebauer (1998) carried out a study on internet-based intermediaries of real estate market, where the role of intermediaries in the age of emerging technologies like the internet and the World Wide Web (www) using econometric model were examined. They found that the basic function of internet-based intermediaries did not differ significantly from their traditional counterparts and subsequently reducing transaction costs and improving the matching between supply and demand. They concluded that the ubiquity of

internet and the ease of market entry allowed the spread and integration of so far geographically separated market places and that lower transaction costs and the availability of high quality information would encourage potential sellers and buyers to actually join the market.

In the United State of America, Crowston, Sawyer, Wigand and Allbritton (2000) explored how the use of ICT affects the work lives of real estate agents, the process of selling /buying houses and the overall structure of the residential real estate industry. In the study, three major ICT factors identified include, those for basic technologies (telephone and multiple listing service, and fax and cell phone), communications technology (beeper and voice mail) and advanced technologies (email, Web, PC, Personal Digital Assistant PDA). The study found that some of the basic technologies (telephone and MLS) are used almost universally, while others (e.g. PDA and Web) are used and valued by only a few agents.

Muhanna (2000) examined how real estate firms adapted to the internet and assessed their perceptions regarding its potential. About 150 estate firms in Ohio Columbus were surveyed and analysed using t-Tests and ANOVA techniques. The analysis showed that the size of the firm was a key determinant as to whether the firm is on the internet, which is consistent with various studies showing that small real estate firms like small businesses in general tend to be slower in embracing new information technologies (Mac Gregor and Bunker, 2000). The result also suggested that real driver behind the push to adopt the new technology stemmed not from a fear of losing business, but largely from a desire to leverage the new medium to attract new buyers and reduce marketing and customers' acquisition costs.

Dixon, Marston, Thompson and Elder (2003) examined how eBusiness could change locational and office space requirement in the future. The study which was carried out on London office market showed that there was a digital divide at the company level in terms of broadband access in the city and that variations in density occurred between firms of different sizes and by different sector and these densities may expect to change over time through technology led change and other factors. They concluded that in addition to ICT, other factors such as transport problems, sustainable development and human resources (demands and needs of employees and homeworking) were centrifugal factors/forces dispersing business and markets away from the city.

Similarly, Rowley (2005) studied the evolution of internet business strategy in the UK estate agency, where he examined the estate agency sector as a case study of an industrial sector in which the internet business model has evolved from experimental dot.com towards the integrated use of internet to enhance service delivery. The study found that portals or website provided content in the form of information, advice and news, link to other businesses including individual estate agency chains, search facilities, and opportunities for registration which support personalisation of communication with customers.

Li and Wang (2006) conducted a study on real estate agency in China in the information age. The analysis revealed that internet allowed agencies to broaden their business opportunities and also served as a connection between the agencies and a fragmented customer base. It did not pose threat to the agents in Beijing in various circles, but worked to increase the competitive advantages including more collaboration and market innovations. The impacts and changes felt on the Beijing real estate agency industry resulting from changes in information Technology were highly correlated with the parallel changes in the socio-economic system in China.

McDonagh (2006) studied the trends in the use of the internet for marketing residential real estate in New Zealand over a period of twelve years. A wide range of real estate issues including listing, marketing and selling practices, advertising and commission costs, pricing trends, market share of real estate agencies, spatial movement and other demographic characteristics of buyers and sellers were discussed. It found that the use of the internet for marketing of residential real estate has grown rapidly, doubling approximately every two years

and that change in technology have made the features, such as multiple photographs, movies, maps, visual walk-throughs and multi criteria searching earlier predicted by Thrall in 1998 a reality. Also that, the web has lowered barriers to entry to the real estate industry with some evident growth in private sale and that buyers and sellers have preference for a small number of easy navigable websites with comprehensive listing rather than a plethora of individual broker sites.

Mazumder and Chatterjee, (2007) studied a business process view of the impact of ICT in real estate sector. They are of the view that the availability of ICT to the masses enabled medium and small size business houses to adopt the business enablers. Also the development in the following areas viz: user friendly GUI (Graphical User Interface) based operating system; scalable database; internet and related network technologies, and communication technology are seen as the primary drivers for ICT revolution. The main functions in a real estate organisation such as purchase and inventory, project, sales and marketing, and facility Management and services have been influenced by the use of ICT.

Bello and Ashaolu (2010) conducted a study on Teleworking and the demand for office space in Lagos Island, Nigeria, where the effects of teleworking on the demand for office space and retail shops were examined. The study found that teleworking is favourably perceived as a welcome alternative to the usual long time and high cost office commuting on the Island. They also found that face-to-face contact at work is not a significant factor in office space demand, and that there is a growing tendency of ICT to replace some traditional clerical office personnel.

Bello (2010) looked at the impact of information technology on estate management profession in Nigeria. The focus was on the challenges posed to the practitioners, how it has affected the procedure and the services rendered by estate surveyors. He reviewed specific areas in which ICT has impacted on the profession which include office automation; real estate agency; land administration and information management system (LIS); globalisation and international property investment; the effect of GSM base station on property value, and lastly the demand for commercial space. In the area of real estate agency, he was of the view that the use of internet for marketing real estate is at the lowest web compared to what operates in the developed nations.

Razali, Manf and Yassin (2010) studied "Internet business strategies by property companies in Asia focusing on 30 top listed property companies and examined their relationship with the internet business strategy index. A scatter plot analysis was used to generate a ranking and score mean among the companies, while rank correlation analysis was also used to identify connection between top 30 property companies in Asia and internet business strategy. The overall result of the relationship between internet business strategies and scatter plot analysis between two indexes for all countries showed that top companies in Asia have good internet business strategies according to listed attributes. The study also showed that there were correlations on the relationship between the 30 top Asian companies and the internet business strategy index, and that though the traditional way of marketing was still in use, the modern and more advanced way was rapidly taking over.

In the work of Oni (2011) "Digital Divide: A challenge to Building the 21st Century Real Estate Professionals in Nigeria? He defined digital divide as lack of access to and effective use of information and communication technology (ICT) which represents the difference between people with access to ICT and who use it effectively and those who do not have. In examining this digital divide, Estate Surveyors and Valuers were randomly sampled and analyzed using descriptive statistical techniques. He found that there was a digital divide amongst the Estate Surveyors and Valuers in Nigeria which he attributed to lack of adequate training and exposure right from the higher institutions of learning.

Alias and Pui Jeffery (2012) investigated the effectiveness of the application of internet in the marketing of residential properties. The research was conducted to survey both the buyers and the sellers whose perspectives and opinions were pooled together and analysed using descriptive statistical techniques. It found that Websites are using links- a search engine like Google and Yahoo and other search engine to attract more buyers and sellers. And also that web has lowered barrier to enter into property industry with some growth in private sales. Some buyers and sellers prefer a small number of easily navigable websites with comprehensive listing rather than too many individual broker sites which conforms with McDonagh (2006) earlier mentioned. Both buyers and sellers agreed on the ease of use, convenience, usefulness, effectiveness as well as being more informative and with an acceptable level of their view on the reliability of internet marketing.

In summary, the literature showed that most of the previous studies were based on internet facilities, and ranged from the adoption of ICT to real estate business; trend in its use; digital divide; to the impact of internet real estate agent and the property market in general. Apart from limiting their studies to internet facilities, none of the studies focused on the use of social media in real estate agency. While some of the mentioned studies limited their attention to either residential, or commercial properties at a time, this study look at agency in its generic form which include both the sales and letting of properties, be it residential or commercial. Similarly, this study included phone calls (GSM) and bulk SMS among the ICT/social media.

3 Research Approach

Stratified random sampling technique was used to sample 220 Estate surveying and valuation firms out of 440 firms practicing within Lagos Metropolis, Nigeria. In each of the selected firms, an Estate Surveyor was sampled. The study area was divided into three geographical zones which are; Lagos Island, Lagos Mainland and Ikeja, where 96, 58 and 67 respondents were randomly selected respectively to make a total of 220 respondents.

Primary data were collected with the aid of structured questionnaire on the respondents. The questionnaire was accompanied by a covering letter to introduce the research focus and instructions to be followed by the respondents. Section A of the questionnaire covers the socio-economic characteristics of the respondents, while section B addressed the specific objectives of the study. Frequency table, cross tabulation and mean ranking were used in the analysis and presentation of the data. The field survey was conducted by the researcher with the support of three field assistants in 2014 and the response rate is as shown in Table 1.

Table 1. Summary of response across the geographical zones

Geographical Zones	Distribution	Retrieval	Percentage
Ikeja	67	59	88
Mainland	95	76	79
Island	58	50	86
Total	220	185	84

(Source: Author's field survey, 2015)

Ikeja had the highest response rate of 88 %, followed by Island with 86% response rate, while Mainland had 79% which is the least response rate across the geographical zones. In all, 185 questionnaire, representing 84% of the total sample size of 220 administered were retrieved.

4 Data Presentation and Findings

Questions were asked to know the correlation between the gender of the respondents and their level of computer certification. The result is contained in Table 2.

Table 2. Chi-Square test of gender and computer certification

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.095	1	0.148		
Continuity Correction	1.482	1	0.223		
Likelihood Ratio	2.255	1	0.133		
Fisher's Exact Test				.174	.109
Linear-by-Linear Association	2.083	1	0.149		

(Source: Author's field survey and analysis, 2015)

The result of the chi-square test as contained in Table 2, with significant level of 0.109 showed that the proportion of males practitioners who have had computer certification was not significantly different from the proportion of female who have had computer certification.

4.1 Social Media in Use in Real Estate Agency

The respondents were asked to indicate the various ICT media their firms employed in the course of undertaking real estate agency transactions. The multiple structured questions were analysed and the result presented as shown in Table 3.

Table 3. Frequency table of ICT media used in agency transactions

S/ N	ICT use in Agency transactions	Responses	
		Frequency	Percentage
1	Blog	10	0.9
2	Email	183	16.4
3	Facebook	156	13.9
4	YouTube	6	0.5
5	LinkedIn	30	2.7
6	Search Engine	75	6.7
7	Phone call	182	16.3
8	Property Website	144	12.9
9	SMS	144	12.9
10	Twitter	60	5.4
11	WhatsApp	129	11.5
	Total	1119	100.0

(Source: Author's field survey, 2015)

The result in Table 3 showed the overall use of ICT media in real estate transactions. It revealed that E-mail had the highest frequency of 183 which represented 16.4%. This was followed by phone call with a frequency of 182 which represented 16.3%, while Facebook had a frequency of 156 which represented 13.9%. Both Website and Bulk SMS had a frequency of 144 each which represented 12.9%. YouTube was the least used ICT medium with a frequency of 6

which represented 0.5% followed by Blog and LinkedIn with frequencies of 10 and 30 each which represented 0.9% and 2.7% respectively.

Table 4 showed the result of the ICT media cross tabulated against the geographical locations. It showed that in Ikeja, E-mail and Phone call both had a frequency of 59 each which represented 32.2% and 32.4% within the ICT group. These were followed by Website with a frequency of 53 which represented 36.8% within the group.

Table 4. ICT media and location cross tabulation

ICT VARIABLES	Geographical Zones			TOTAL
	Ikeja	Mainland	Island	
Blog Count	3	2	5	10
% within Blog use in Transactions	30%	20.0%	50%	100%
Email Count	59	76	48	183
% within Email use in Transactions	32.2%	41.5%	26.2%	100%
Facebook Count	51	62	43	156
% within Facebook use in Transactions	32.7%	39.7%	27.6%	100%
YouTube Count	2	2	2	6
% within YouTube use in transactions	33.3%	33.3%	33.3%	100%
LinkedIn Count	14	0	16	30
% within LinkedIn use in Transactions	46.7%	0%	53.3%	100%
Search Engine Count	30	27	18	75
% within Search Engine use in Transactions	40.0%	36.0%	24.0%	100%
Phone Call Count	59	75	48	182
% within Phone call use in Transactions	32.4%	41.2%	26.4%	100%
Website Count	53	53	38	144
% within Website use in Transactions	36.8%	36.8%	26.4%	100%
Bulk SMS Count	35	69	40	144
% within Bulk SMS use in Transactions	24.3%	47.9%	27.8	100%
Twitter Count	11	37	12	60
% within Twitter use in Transactions	18.3%	61.7%	20.0%	100%
WhatsApp Count	41	54	34	129
% within WhatsApp use in Transactions	31.8%	41.9	26.4%	100%

(Source: Author's field survey, 2015)

In Mainland, email had the highest frequency of 72 which represented 41.5%, this was followed by Phone call with a frequency of 75 which represented 41.2% within the group and Bulk SMS with a frequency of 69 which represented 47.9% within the group.

Island showed similar result to that of Ikeja because email and Phone call also had the highest frequencies of 48 each, which represented 26.2% and 26.4% respectively within each ICT group. These were followed by Facebook with a frequency of 43, which represented 27.6% within the group. It was observed however that across all the groups, YouTube was the least ICT media used in real estate agency transactions.

4.2 The Level of Usage of ICT in Real Estate Practice

The level of usage of ICT was also measured along with other conventional property listing media in real estate transactions agency with particular reference to sale and letting transactions. The responses were analysed to evaluate the level of usage of ICT in real estate practice.

Table 5. Frequency of ICT use in transactions

Use of ICT	Frequency	Percentage
Seldom	16	8.6
Sometimes	54	29.2
Always	115	62.2
Total	185	100

(Source: Author's field survey, 2015)

Table 5 showed the responses in respect of the frequency of ICT used by estate surveyors and valuers in agency transactions. The result revealed that 115(62.2%) of the respondents, always made use of ICT. While 54 (29.2%) of the respondents used ICT sometimes, the remaining 16 (8.6%) claimed to seldomly used ICT for real estate agency transactions.

A comparison of the level of use of the social media with other conventional media was done. The mean ranking is as shown in Table 6.

Table 6. Mean Table of Property Listing Media for Agency Transactions

S/N	Variables	Sales		Letting		Total	
		Mean	Ranking	Mean	Ranking	Mean	Ranking
1	Banner	4.13	2	4.37	2	4.25	2
2	Bulletin	3.91	4	4.35	3	4.13	4
3	Newspaper	2.64	10	2.69	10	2.67	10
4	Magazine	2.97	9	2.87	9	2.92	9
5	Phone call	4.43	1	4.51	1	4.47	1
6	Bulk SMS	3.45	6	3.49	5	3.47	6
7	Digital Billboard	1.37	15	1.34	15	1.36	15
8	E-mail	4.11	3	4.16	4	4.14	3
9	Website	3.72	5	3.41	6	3.57	5
10	Blog	1.41	14	1.46	14	1.44	14
11	Facebook	3.14	8	3.14	7	3.14	8
12	YouTube	1.24	16	1.27	16	1.26	16
13	Search Engine	2.25	11	1.99	12	2.12	12
14	Twitter	2.01	13	2.27	11	2.14	11
15	LinkedIn	2.06	12	1.82	13	1.94	13
16	WhatsApp	3.26	7	3.11	8	3.19	7

(Source: Author's field survey and analysis, 2014)

Table 6 shows the mean ranking of the level of use of conventional and the social media in real estate transactions. GSM Phone ranked first with a mean value of 4.47 followed by Banner with a mean value of 4.25, and email with a mean value of 4.14. The least ranked media include YouTube with a mean value of 1.26. While digital billboard has a mean value of 1.36, Blog has a mean value of 1.44.

Table 7. Mean table of factors influencing the use of ICT/social media

VARIABLE	MEAN	RANKING
Service Failure	3.89	1
Power Failure	3.79	2
Service Cost	3.52	3
Awareness	3.24	4
Maintenance	3.11	5
Literacy	2.98	6
Specialised Skill Required	2.97	7
Staff training Cost	2.59	8
Regulation	2.58	9
Government Policy	2.42	10
Space Availability	2.36	11

(Source: Author's field survey and analysis, 2014)

Table 7 showed the result of mean ranking of the identified factors influencing the use of ICT in real estate agency. From the table, service failure ranked first with a mean of 3.89, followed by power failure with a mean of 3.79, while service cost ranked third with 3.52 mean. The three highest ranked factors are internet/ power related issues.

In contrast, space availability ranked least with a mean of 2.36 followed by government policy and regulation with 2.42 and 2.58 means respectively.

5 Discussions

The study revealed that there was no association between computer certification and gender. This an indication of the level importance attached to computer literacy among the practitioners for real estate practice. In order word computer skill was embraced by all regardless of gender. Furthermore, email was the mostly used social media by estate surveyors in real estate agency transactions, closely followed by phone call. The prevalent use of email could be because it provided a platform for privacy and documentation in agency transactions which may also be used as an evidence in the case of dispute over fee or mandate. On the other hand, Youtube was the least used social media in agency transactions. This could be as a result of the complexity involved in its use which involve video recording and some technicalities in uploading the recorded video which apparently will be more costly. This is in line with the earlier finding by Crowton, et al (2000) and suggest that basic technologies are used almost universally, while others are used by only a few agents.

Besides, the study found that the three geographical locations, Ikeja Mainland and Island have similarity in the order of use of ICT media in agency transactions, in which e-mail was the mostly used ICT, followed by Phone call. They however exhibited differences in what was ranked third which included Website, Bulk SMS and Facebook respectively. This indicated that location has no effect on the use of ICT/ social media in real estate transactions as long as there is internet connection (network).

The use of ICT in the agency transactions, by 62.2% indicated that the Nigerian estate surveyors have embraced the global trend of internet-related marketing which has the tendency of giving marketing of property (either for sale or letting) a wider publicity. This could enhance market competition and allows for the realisation of best price in a real property transaction.

The study also showed that conventional mean of listing of property in real estate agency transactions was still very much in use and relevant despite the level of technological development and adoption of social media. This was evidenced by the use of banner which ranked second to the use of Phone call. This could be attributed to the localised nature of property market.

Lastly, the study found that service failure was the most prominent factor that influenced the uses of ICT/social media in real estate transactions followed by power failure and cost of the services. Service failure as a major challenge people experienced in the course of using ICT at one time or the other may affect the timing of real estate agency transaction and thereby create unnecessary anxiety. Similarly, the effect of Power failure is that it could also cause service interruption and at the same time increase the overhead cost of some business activities if not totally paralysed. Similarly, the cost of obtaining data for internet connection appeared to be on the high side. This may limit the number hours to which an agent get connected to the internet thereby reduce the efficiency of the social media in real estate transactions.

To a large extent, space availability does not in any way influence the use of ICT and also the fact that government does not regulate the use of the social media and hence would not be a threat to its use.

6 Conclusion

The result revealed that the use of ICT has no correlation with the gender of the Nigerian real estate practitioners who had embraced the use of social media for real estate transactions in order to enjoy wider marketing coverage. Also that the use of social media had no relationship with the geographical location of the agent.

This study had attempted to enquire into the adoption of Information and Communication Technology in real estate agency transactions. The analysis of relevant data in line with the aim and objectives of the study showed that Email, Phone call and Facebook were the the mostly used ICT media of all the identified social media used in real estate agency transactions by practitioners, while YouTube, Blog and LinkedIn were the least ICT in use.

The study further showed that the use of ICT/ social media was mostly influenced by service failure (in terms of connectivity), power failure (energy to power the system) and cost (of obtaining data). While service failure, power and cost still influence and determine the effective use of the social media for real estate transactions, it can be said that Nigerian government does not in any way regulate the use of the social media and as such does not portend any threat to its use or non-use.

The policy implication is the need for government intervention by investing more on broadband and to also ensure regular supply of power/electricity so as to enhance effective use of ICT/social media in real estate agency transactions by the practitioners in Nigeria.

7 References

- Ajayi, C. A. (1998). *Property Investment Valuation and Analysis*. Ibadan: De-Ayo.
- Alias, A., & Pui, J. (2012). Internet Marketing of Residential Property. *Journal of Surveying, Construction and Property*, 3(1). Retrieved may 2014
- Babatunde, J. (2012). *Real Estate Transactions. A Modern Approach to Estate Agency Practice in Nigeria*. Abuja: Jitaset.
- Becker, G. (1975). *Human Capital:A Theoretical and Empirical Analysis*. New York: National Bureau of Economic Research.
- Bello, M. O. (2010). *The Impact of Information Technology on Estate Management Profession in Nigeria. Being a paper presented at the Osun State mandatory continuing*

- professional development (MCPD) seminar organised by the Nigerian Institution of Estate Surveyors and Valuers.*
- Bello, M.O. & Ashaolu, T.A. (2010). Teleworking and the Demand for office space in Lagos Island, Nigeria. *Journal of Sustainable Development*, 3(4), 241-247.
- Buxmann, P., & Gebauer. (1998). Internet-Based Intermediaries- The Case of the Real Estate Market. *CMIT Working Paper 98-Wp-1027 in proceedings of the sixth European Conference on Information system*, (pp. 1-15).
- Crowston, K. &. (1998). Use of Web for Electronic Commerce in Real Estate. Retrieved 2013, from crowston.syr.edu/system/file/amics98
- Dixton, T., Marston, T., & Elder, B. (2003). e-Business and the city of London office Market. *Journal of Property Investment and Finance*, 21(4), 348-365.
- Li, L.H., & Wang, C. (2006). Real Estate Agency in China in the Information Age. *Property Management*, 24(1), 47-61.
- Muhanna, W. (2000). E-Commerce in the Real Estate Brokerage Industry. *Journal of Real Estate Practice and Education*, 3(1), 1-16.
- Oni, O. (2011). *Digital Divide: A Challenge to Building the 21st Century Real Estate Professionals in Nigeria? Being a Paper delivered at the Estate Management Student Association (EMSA) annual week University of Lagos.*
- Razali, M.N., Manaf, Z., & Yassin, A.M. (2010). Internet Business Strategies by Property Companies in Asia. *Journal of Property Management*, 28(4), 270-289.
- Rodriguez, M. (2011). *Making Social Media Effective In Real Estate*. Baylor University. Texas: Waco.
- Roulac, S. E. (1996). Strategic Implications of Information Technology for Real Estate Sector. *Journal of Property Finance*, 7(2), 28-44.
- Rowley. (2005). The Evolution of Internet Business Strategy: The case of UK Estate Agency. *Property Management*, 23(3), 217-226.

ASSESSMENT OF GROWTH CHALLENGES AMONG SMALL AND MEDIUM-SIZED CONSTRUCTION FIRMS IN GHANA

Arthur-Aidoo, B. M.; Aigbavboa, Clinton Ohis; Thwala, Didibhuku Wellington
Department of Construction Management and Quantity Surveying, Faculty of Engineering and Built Environment, University of Johannesburg, Johannesburg, Gauteng, South Africa

Abstract

The purpose of this paper is to present findings on the challenges that small and medium-sized firms in the Ghanaian construction industry encounter in relation to growth in their operations. The study made use of in-depth literature review on the growth of small and medium-sized firms. This was secondly supported by the use of semi-structured interviews that were conducted among construction professionals. This exploratory study used a relatively small number of professionals as interviewees since it is an ongoing Ph.D. study and was embarked on a pilot study with the expectation that a large targeted population size will be considered at the later stage of the studies. This assessment will enable construction SME's to have an in-depth understanding regarding realistic growth challenges with possible mitigation control measures. The results demonstrated that though both internal and external factors of firm's growth pose a problem, it is the external challenges such as access to funds, influence from foreign markets and institutional regulations that act as strenuous challenges. Additionally, the respondent expressed that lack of ideas, new products and insufficient knowledge were also captured as growth challenges for SMEs. The study demonstrates that small and medium-sized construction firms do encounter growth challenges, and these are attributed to both internal and external forces of the companies operations.

Keywords: Assessment, Growth, Challenges, SMEs, Construction

1 Introduction

The contemporary global competitiveness of firms operating both within and outside an industry have compelled these firms to adopt strategies to grow in order to meet their goals. This growth cannot ensue without a thorough assessment of the significant barriers that impede growth. Therefore, appraisal of growth challenges within small and medium-size firms is crucial. This paper examines the challenges encountered by small and medium-sized construction firms in Ghana. A number of literature on SME's have emphasized on their successes factors particularly with the study done by Yasuda (2005) and Yang and Huang (2005) which captured major determinants of firm's growth. However, before the growth success limit of a company would be attained and sustained, it is fundamental to envisage and explore the challenges of growth and as such put in place mitigation and control measures. The growth of SME's must not also be underestimated due to the significant roles that SME's play in the socio-economic development of the nation. As a result, of their roles they play, the importance of small and medium-sized firms is widely recognized in both developed and developing economy (Agyakwa-Baah 2010). Mahemba (2011) stressed that largely in most economies small and medium-size firms have historically played a vital role in the creation of

jobs, stimulating innovations and thus contributing growth (Storey 1994). This study, therefore, seeks to highlight the realistic growth challenges within the construction industry in Ghana and further provide possible mitigation control measures for the SME's thereby contributing to knowledge.

2 Growth among SME's

Growth ensues in order for firms to achieve their core objectives and strategic intent including increasing sales, maximising profits or increasing market share. Firms grow in two distinct ways namely internal expansion (organic) and through integration (inorganic). Growing organically, a company needs to retain sufficient profits to enable it to purchase new assets, including new technology. Over time, the total value of a firm's assets will rise, which provides collateral to allow it to borrow to fund further expansion. The second route to achieving growth is to integrate with other firms. Firms combine through mergers, where there is a mutual agreement, or through acquisitions, where one firm purchases shares in another corporation, with or without agreement. There are several types of integration, including vertical integration and horizontal. Vertical integration occurs when firms merge at different stages of production. There are two other types of vertical integration namely backwards and forwards. Horizontal integration, on the other hand, occurs when firms merge at the same stage of production. Horizontal integration is also referred to as *lateral integration*. Beck *et al.* (2006): Triki *et al.* (2011) suggest that one of the key drivers of sustainable growth in developing countries is firm growth and productivity. As a result, comprehending firm's growth has now become a great concern for researchers and policy makers. Various definition of firm size has been advanced without reaching a consensus on a uniformly acceptable definition. However, the definition commonly adopted in Ghana in the context of the study is summarized in Table 1.

Table 1. Summary of definitions of SMEs commonly adopted in Ghana

Item	Source of definition SME	Definition
1	Ghana Statistical Service (GSS)	Firms with less than ten employees are considered small, and those with more than ten employees are medium or large.
2	National Board for Small Scale Industries (NBSSI) (1996)	Micro enterprises are defined as enterprises employing 1-5 workers with fixed assets (excluding reality) of value not exceeding \$10,000 and Small Scale Enterprises as those that operate 6-29 persons or have fixed assets (excluding reality) of value \$100,000.
3	Bank of Ghana under the Funds for Small and Medium Enterprises Development (FUSED) (Boch-Ocansey, 1996)	Defined micro and small enterprises as businesses with assets of million cedis and 25 million cedis in constant 1988 prices (US \$20,000 and US \$100,000 equivalent) respectively.
4	Ayeetey et al. (1994)	Defined micro businesses as companies employing 1-9 persons; small as those employing 10-29 persons; and medium as those which employ 30-40 persons.
5	Mensah (2004)	Defined micro businesses as businesses employing up to 5 persons with fixed assets (excluding reality) not exceeding \$10,000 in value; Small businesses as those which use 6-29 with fixed assets (excluding reality) up to \$100,000 in value; and Medium businesses as those, which employ 30-99 persons with, fixed assets of up to \$1 million in value.
6	Eyiah and Cook (2003), Eyiah (2004)	Defined construction SMEs as contractors registered in financial classes 2, 3, and 4.

(Source: Adapted from Kheni, 2008)

Therefore identifying the channel that promotes small and medium-sized company's growth in Ghana will provide the basis to influence policy direction to create the environment and required initiatives to help other informal sectors. Further, this will help to create the right platform for financing SME's firms to grow given the right Government and institutional support. The Government of Ghana through the Senchi report (2014) stressed the need for the state to encourage and promote indigenous entrepreneurship as well as providing further steps to support small and medium scale enterprises. There is dearth accessible data on SME's in Ghana, but the working available statistics from the Registrar General's Department recommend that 92 percent of companies registered are micro, small and medium enterprise. In Ghana SME's are now exposed to greater opportunities than ever for expansion and diversification of the sectors. While developed global markets may be shrinking on account of the financial and economic crises prevailing, Ghana's market size is growing, and opportunities within Africa are also beginning to look attractive for SMEs.

3 Challenges to SME's Growth

Louis and Macamo (2011) maintained that there are significant barriers to SME's growth in most market economies except the most flexible and deregulated economies. Small and Medium-sized firms, as captured in literature, is the engine of growth of most economies and are expected to drive these economies to enhance growth thereby minimizing significant barriers. As a result, there is the need to give attention to the set of the barriers which hinder the growth of potential fast growth firms that have the greatest capacity to provide employment and bring in novelty in technologies. Although, growth to a considerable extent is a matter of willingness and skill, the fundamental facilitators and barriers in the environment cannot be disregarded (Davidsson *et al.*, 2005). Davidsson (1989) cited in Zhou and Wit (2009) affirmed that there are generally some determinates that facilitate firm's growth as well as other factors too that hinder potential growth, such factors that hinder are the growth barriers. These barriers may be classified as either internal or external. According to Amarijit and Nahum (2012), the literature on growth barriers to firm shown that there are different barriers to small business growth in various countries of the world. This may be because of the different economic situations, rules and regulations, political system, market competition, and legal system of different countries.

3.1 Financial Barriers

Zhou and Wit (2009) indicated that the common barriers encountered by SME's include institutional barriers, barriers emanating firm's internal operations and financial barriers. Studies by (Becchetti and Trovato, 2010; Pissarides, 1998; Riding and Haines, 1998) have established the main obstacle to the growth of SME's like the financial barriers which includes credit constraints, lack of external debt, and equity capital. Evidence shows that banks and other financial institutes are conservative to make loans and credit facility available to SME's. This is because the majority of these SMEs do not have collateral, and also, they are new entrants in the business with limited capital. Bartlett and Bukvic (2001) stressed that the financial barriers to SME's growth include high collateral, high bank charges and fees, lack of outside equity and venture capital and the high cost of credit. Levey *et al.* (1999) cited in Abor and Quartey (2010) supported that there is limited access to financial resources available to SME's compared to large organization and consequences for their growth and development. Financial assistance is, therefore, paramount for the development of small and medium-size firms (Cook and Nixton 2000). Green *et al.* (2002) affirmed that lack of funds is considered the fundamental reason why the business is failing to start or to progress. Therefore, finance is a binder that holds together all various aspects involved in the SME business start-up and development. Other inhibitors include inefficient functioning of financial markets, inadequate

security and enforcement of property rights, poor provision of infrastructure, ineffective regulation and taxation, and broader governance features such as corruption (Ayyagari *et al.*, 2008). SME's face difficulties in gaining access to the market because of inexperience, lack of managerial marketing ability and lack of access to capacity that contributes to growth.

3.2 Institutional Barriers

According to Bartlett and Bukvic (2001), the institutional framework within which SME's operate and interact with customers and government can act as a barrier and influence the firm's economic performance and growth. What SME's often face in their growth is the institutional constraints. Complex regulation and laws pose as huge barriers to the growth of SME's particularly to new entrants firms and expansion of existing SME's. Bartlett and Bukvic (2001) stressed that institutional constraints may be in terms of the unsuitable tax system, strenuous legal policies and other discriminate rules that grow towards SME's tends to hinder their growth. Smorfitt (2008) cited in Louis and Macamo (2011) asserted that a weak legislation that does not support the growth and development of SME's and it may also hinder their growth strategy. Further, the huge start-up cost for firms including licensing and registration requirements may also impose burdens on SME's (Abor and Quartey 2010). Davidsson & Henreksson (2002) cited in Zhou and Wit (2009) established that consistent results from both empirical and theoretical data show that individual institution internationally discriminates against the growth of SME's which in turn act as a barrier. Economies of nations where political activities have polarized SME's operations. As a result, any political instability will cause a major constraint having an adverse impact on the productivity of manufacturing sector featuring poor business environment. Gyimah-Brempong (2004) observed that high level of the risk factor is attached to the presence of weak institutions that leads to political instability with a considerable negative impact on overall economic growth thereby providing an additional stronger adverse effect on the performance of individual firms. Institutional barriers for SME firms may also be in the form of stringent procurement laws regarding award of contracts, the supply of materials and payment issues on works done by firms' issues.o

3.3 Social Barriers

According to Bartlett and Bukvic (2010), economic sociology has stressed on how vital the connection between entrepreneurs and social capital, trust and networking, is for facilitating the growth of SME's sector. This is because without a certain level of trust between businesses partners; there will be the absence of reliance on individuals or firms that may prevent the transaction being carried out. Bartlett and Bukvic (2010) further pointed that without trust among business partners, transaction cost will be exposed and with the possibility of the opportunistic, taking advantage. Also, the reliance on personal connections replace the unsigned market operation as a fundamental for doing business thereby increasing corruption among others in the process. SME's may overcome such barriers by having an institutional, regulatory support network service. The ideal services in the form of advice, provision of information and training may aid in controlling such barriers (Bartlett and Bukvic, 2010). Although there is dearth of literature on this category of growth barrier within the firm, however, this social barriers may emanate when SME firms or any of its partners is engaged in social vices such as theft or pilfering of items, corruption drug trafficking will tend to reduce the prestige of the firm thereby affecting its entire growth in the long run.

3.4 Barriers Internal to the Firm

Internal walls that are classified organizational barriers also hinder SME's growth. These include skills and knowledge, managerial capacity, mission statement and vision of company among others. Further, SME's owners need to be aware of the business life-cycle and be able

to determine the stage their business has gotten to and the need to expand. However, if owners are unable to identify this stage, their business will stagnate without any growth or expansion. The internal barrier may also arise from the entrepreneur's reluctance to let go of control to the professional manager (Storey, 1994) as cited in Louis and Macamo (2011). The lack of managerial know-how places significant constraints on SME's development. Further, the dearth of management talent and skills prevalent in most countries has a magnified impact on SME's (Abor and Quartey 2010). Kaynula and Quartey (2000) assert that despite the numerous institutions providing training and advisory services, there is still the skills gap in the SME sector as a whole. This is because of the associated massive charge that comes with these training services and as such owners of these SME's do not recognize the need to upgrade the skills of their employees (Abor and Quartey, 2000). Similarly, Aryeetey *et al.* (1994) emphasised that small and medium size firms challenge in terms of technology in gaining access to appropriate technologies. Capacity limitations of the company, shortage in resources (human and capital) and its management may constitute barriers internal to the firm (Bartlett and Bukvic, 2001). Shakantu *et al.* (2007), Uriyo, *et al.* (2004) and Kapulula (2008) cited in Tsheliso (2012) on the other hand categorised the barriers to the development of SME's growth as: (i) Environment regulations, (ii) Inadequate infrastructure, (iii) business regulations, (iv) Tax and labour laws, (v) Skills shortage, (vi) Corruption, (vii) Political interference and (viii) choice of technology.

4 Research Methodology

In order to achieve the purpose of this study, an integration of in-depth literature review supported by semi-structured interviews was adopted. The research design commenced with the structured interview with prior arrangement with the interviewees via both telephone and e-mails. A relatively small number of construction professionals were engaged as a pilot study since this study is an ongoing Ph.D. study which is expected to consider a larger population size at the later stage of the study. Nine professionals in all were interviewed via purposive sampling with each interviewee having eight minutes duration and was recorded and transcribed. The interview was guided by a schedule and was one-on-one in nature due to the constraint involved in assembling together all the targeted population. Among the population interviewed were Project Managers, Construction Managers, and Quantity Surveyors and General Managers in charge of small and medium-sized construction firms. Interviewees also had enough time to enquire further about the study and also expressed their candid views through their answers. Descriptive analysis was adopted using the main and sub-themes from the interview schedule. Further, the ongoing Ph.D. study intends to use a mixed method, however, to enable the interviewer to elaborate further the questions to interviewees; the study made use of the qualitative strategy specifically the use of interviews.

5 Findings and Discussions

These exploratory findings are consistent with the literature regarding the fundamental features of employee relations. The way in which organisations maintain employee relations is often informal nature. All companies could articulate the principal theme, possess objectives and techniques for the management of employee relations within their organisations (Dainty *et al.*, 2002).

The initial interview that engaged three project managers ensued at the project office during their lunch break. Two of the Project Managers coincidentally had six years of experience with the one having years experience working with small and medium-size firms. All the Project Managers unanimously agreed and remarked that small and medium-size firms encounter challenges especially in the sourcing of fund from financial institutions. Further, the respondent indicated that the prerequisite and requirement needed by such financial institutions are so

difficult to be fulfilled and as such it renders the job creation and perhaps envisages novelty that will emanate from the project to be facilitated by such funds nullified. The Project Managers (PM) stated that growth is also hindered internally as a result of poor human relation among project teams which hampers targets and goals are thereby hindering entire growth within the firm. The respondents further noted that these poor human relations among project team ensue when there is prejudice by management as well as the lack of harmony within the organization. The second session of the interview engaged Construction Managers (CM) and Quantity Surveyors (QS). The Construction Managers on the front-line of the project execution phase affirmed that though assessing capital pose a challenge for Small and Medium-size firms, its impact is really only felt by new entrant firms into the business. Quantity Surveyors, on the other hand, remarked that assessing of financial capital by SME's is a critical challenge for both new entrant and existing firms. Both Construction Managers and Quantity Surveyors indicated that stringent legal policy and legislation impose an additional challenge for small and medium-size firms to growth thereby creating flexibility for large companies to expand. The respondents further stated that unbearable taxation system among drives most SME's into liquidation. The CM and QS added that there are internal attributes within SME firms that pose challenges to growth and as such those characteristics are unique to each firm.

The final session of the interview engaged General Managers of Small and medium-size firms. This session of the interview brought to light general administrative challenges that avert growth such as the lack of requisite skills need to embark on a particular task, lack of experience and knowledge, lack of dynamic management structure in place to drive growth rather than focusing on profits after project and finally lack of periodic employee development training programmes. The General Managers also remarked that majority of SME's are owned by either a family or run by individuals. As a result, there is no proper structure of control. This is because the owners mostly interfere with the decision taken once that is not in their interest as such this hinders growth. Further, the respondent added that assessing of credit facility from the banks for their operations has always been a challenge.

6 Conclusions

The purpose of this paper is to examine the challenges encountered by small and medium-sized construction firms in Ghana. In order to achieve this purpose semi-structured interviews were conducted among construction professionals on various sites, and this was supported by a desk-top study on the theme. Evidence from the data gathered on the populations shown that small and medium-size firms do encounter challenges to growth were as a result of both internal and external factors. The study further revealed that internal challenges to the growth of SME's included lack of good management procedures such establishing good human relations policy among teams to stimulate goals and targets to be met to enhance the growth of firms. Also, lack of available managerial skills among SME's posed as a challenge as well as owners of SME's inability sponsor for training programmes to upgrade their staff due to the associated huge charges involved in such programmes. This study further identified another significant challenge as the assessing to financial credit loans and bonds from banks and other financial institutions facing construction SME's in Ghana. This is because most of the requirements demanded by the bank and other financial institution were not so easy to be met by the firms. Also, because the majority of these SME's were new entrants into the business, they do not have any collateral in order to help them assess any credit facility. In addition, this study also concludes that the stringent institutional, legal policy imposes additional challenges to small and medium-size firms' on growth. This includes high taxation system, the huge start-up cost for firms including licensing and registration requirements that also hinder the growth of construction SME's in Ghana.

7 Reference

- Abor, J. and Biekpe, N. (2006) Small Business Financing Initiatives in Ghana, Problems and Perspectives in Management. Volume 4, Issue 3, 2006
- Abor, J. and P. Quartey (2010). Issues in SME Development in Ghana and South Africa. *International Research Journal of Finance and Economics*. Issue 39 available at http://www.eurojournals.com/irjfe_39_15.pdf
- Agyakwa-Baah, A. (2009). *A Study into Risk Assessment and Management Practices within Ghanaian Medium and Large Construction Organisations*. MSc project dissertation. Sheffield Hallam University, United Kingdom.
- Aryeetey, E., A. Baah-Nuakoh, T. Duggleby, H. Hettige, and W. F. Steel, 1994. "Supply and Demand for Finance of Small Scale Enterprises in Ghana", Discussion Paper No. 251, World Bank, Washington, DC.
- Bartlett, W., & Bukvič, V. (2001). Barriers to SME growth in Slovenia. *MOCT-MOST: Economic Policy in Transitional Economies*, 11: 177-195.
- Beck, Thorsten, Asli Demirgüç-Kunt, and Vojislav Maksimovic. 2005. "Financial and Legal Constraints to Firm Growth: Does Firm Size Matter?" *Journal of Finance*. 60 (1): 137–77
- Boch-Ocansey, O. (1996). *Strategies for strengthening small and medium-sized industries in Ghana*. Anansesem Publications Limited, Accra, Ghana.
- Cook, P. and F. Nixon, (2000) "Finance and Small and Medium-Sized Enterprise Development", IDPM, University of Manchester, Finance and Development Research Programme Working Paper Series, Paper No 14.
- Davidsson, P. (1989). Continued Entrepreneurship and small firm growth. Stockholm School of Economics, Stockholm
- Eyiah, A. and Cook, P. (2003). Financing small and medium-scale contractors in developing countries: A Ghana case study. *Construction Management and Economics* 21, 357- 367.
- Green, C. J., P. Kimuyu, R. Manos, and V. Murinde, (2002). "How do Small Firms in Developing Countries Raise Capital? Evidence from a Large-Scale Survey of Kenyan Micro and Small Scale Enterprises", Economic Research Paper No. 02/6, Centre for International, Financial and Economics Research, Department of Economics, Loughborough University.
- Kayanula, D. and Quartey, P. (2000), "The Policy Environment for Promoting Small and Medium-Sized Enterprises in Ghana and Malawi", Finance and Development Research Programme, Working Paper Series, Paper No 15, IDPM, University of Manchester.
- Kheni N. A (2008) *Impact of health and safety management on safety performance of small and medium-sized construction businesses in Ghana*. Published Ph.D. Thesis Loughborough University UK.
- Levy, B. (1993), 'Obstacles to Developing Indigenous Small and Medium Enterprises: An Empirical Assessment', *The World Bank Economic Review*, 7 (1), pp. 65-83.
- Louis M. and Macamo, P. (2011) Barriers to Business Growth: A Study on Small Enterprises in Maputo, University Essay.
- Mensah, S. (2004), "A review of SME financing scheme in Ghana", A Journal presented at the UNIDO Regional Workshop of Financing Small and Medium Scale Enterprises, Accra, Ghana, 15-16 March 2004.
- National Board for Small Scale Industries (NBSSI) (1996). *Enterprise Fund: Providing Long-Term Financing Support to Small and Medium Enterprises in Ghana*. EMPRETEC Foundation, Accra, Ghana.
- National Economic Forum 2014 Report. Changing the narrative: Building a National Consensus for Economic & Social Transformation Senchi, Eastern Region, Ghana
- Parker, R., R. Riopelle, and W. Steel, 1995. "Small Enterprises Adjusting to Liberalisation in

Five African Countries”, *World Bank Discussion Paper*, No 271, African Technical Department Series, The World Bank, Washington DC.

Smorfitt, R. (2008), A critical assessment of the impact of interventions to stimulate the establishment and growth rates of SMEs in the formal sector in Kwazulu-Natal. Ph.D. dissertation. University of KwaZulu-Natal

Storey, D.(1994). *Understanding the small business Sector*. Routledge: London /New York.

Zhou, H. and de Wit, G. (2009), SCALES, Scientific Analysis of Entrepreneurship and SME’s, Netherlands Ministry of Economic Affairs Instruction Industry Development Board.

INDEX OF AUTHORS

A

- Abidoye, Rotimi Boluwatife - 229
Adafin, Johnson Kayode – 60
Adamu, Anita Dzikwi – 135
Adediran, Abdulrauf - 526
Adio-Moses, David Adunadepo - 446
Adjei-Kumi, Theophilus – 71
Agumba Justus Ngala - 477
Ahmed, Omar Hesham - 295
Aigbavboa, Clinton Ohis – 82, 319, 337, 550
Aiyetan, Ayodeji.Olatunji – 357, 376
Ajayi, Cyril Ayodele - 538
Akampurira Emmanuel – 102
Akintola, Adeyemi - 506
Alewi, Monisola Florence - 386
Allen, Christopher James – 191, 486
Anugwo, Iruka C. – 142
Arthur-Aidoo, B. M. - 550
Asaolu, Olumuyiwa Sunday – 446
Ayegba, Calistus - 455

B

- Babatunde Oluwayomi – 249
Babatunde, Theophilus Olugbenga - 538
Badu, Edward – 71
Balogun, Ayodeji - 426
Benviolent, Chigara – 152
Boelhouwer, Peter - 465
Bremer, Tascha – 44
Bwanali, Salim - 112

INDEX OF AUTHORS

C

Chan, Albert P. C. – 229

Coetzee, Drian - 268

D

Dabo, Daniel I. - 53

Dada, Joshua Oluwasuji – 162

Douman, Darcelle – 506

E

Ebunoluwa, Esther Ilori - 327

Els, Mart-Mari – 44, 268

Emuze, Fidelis – 220

Eyiah-Botwe, E - 337

F

Fadason, Ruya T. - 53

Fawale, Tolulope Samuel – 162

Fapohunda, Julius Ayodeji – 260, 496

G

Gbadegesin, Job Taiwo - 465

H

Harry van der Heijden - 465

I

Ilori, Babasola Olubunmi - 202

Ishaya, David Ayock - 53

INDEX OF AUTHORS

J

Jimoh, Richard Ajayi - 399

K

Kajimo-Shakantu, Kahilu - 517

Kelani, Yakubu - 409

Khetheng, Alice - 220

Khodeir, Laila Mohamed – 295

Kissi, Ernest – 71

Kleynhans, Matthew - 506

Kukoyi, Patricia - 240

L

Lam, Ka Chi – 2, 14

Laryea, Samuel - 455

Lee, Eric Wai Ming - 14

M

Maneli, Sithembisile - 506

Matshidze, Lindelani - 418

Micah, Victor Kweku Bondzie – 309

Mooya, Many Mainza – 34, 209

Mthi, Vuyolwethu Feza Philisa - 486

Mustapha, Zakari – 319

Musonda Innocent - 477

Musvoto, Elizabeth Mirika – 209

N

Ndihokubwayo, Ruben - 277

Nyariranwge, Maxwell - 249

INDEX OF AUTHORS

O

- Oboirien, Momoh Ohiomah – 24
Odediran, Sunday Julius – 92, 327
Odeyinka, Henry Agboola – 60
Ogunlana, Stephen - 419
Ogunsanya, Oluwabukunmi Ayopo – 82
Ojo, Grace Kehinde – 327
Okoro Chioma Sylvia - 477
Oladokun, Sunday Olarinre - 465
Omotayo, Omolara Shade - 399
Onungwa, Ihuoma Onyinyechi – 348
Opaleye, Oladele Solomon – 367, 386, 426
Opperman, Alvin Graham - 277
Oshodi, Olalekan Shamsideen – 2, 14
Oyegoke, Adekunle Sabitu - 418

P

- Pinfold, Laura - 260

R

- Rotimi, James Olabode Bamidele – 60
Rwelamila, Pantaleo D. – 112, 409

S

- Saad, Mohammed Mustapha - 182
Saidu, Ibrahim – 124
Samuel, Segun Victor - 367
Schreuder, Jan-Hendrik Michiel - 436
Shakantu, Winston – 124, 135, 142, 357, 376
Solanke, Bukola H. – 496
Soni, Manqoba Sinothile Mholi - 517
Smallwood, John – 152, 240, 357, 376
Splaingard, Daniel Robert - 172

INDEX OF AUTHORS

T

Talukhaba, Alfred Atsango – 202, 367, 386, 426

Taruvinga, Bridgit Gugulethu - 34

Thwala, Didibhuku Wellington – 82, 319, 337, 550

Timothy Tunde Oladokun - 538

U

Uduma-Olugu, Nnezi - 348

Umeokafor Nnedinma - 285

W

Wilkinson, Suzanne Jane – 60

Windapo, Abimbola Olukemi – 92, 102, 285, 399, 526

Wium, Jan Andries - 436

Z

Zenios, Marco - 191

INDEX OF KEYWORDS

A

Accuracy – 14
Accident – 399
Acquisition - 409
Adoption - 348
Architecture – 172, 309
Artificial Intelligence – 446
Assessment - 550

B

Bid success - 162
Box-Jenkins model – 14
Building Information Modelling – 260, 348
Building production processes - 260
Built facilities – 135
Business management - 486

C

Challenges – 53
Cement - 367
Cement mural – 309
Challenges - 550
Change process - 409
Competitiveness – 142
Compliance - 319
Construction – 220, 285, 357, 376, 386, 426, 486, 550
Construction sites - 399
Constructability - 376
Construction demand – 14
Construction companies - 92
Construction education - 44

INDEX OF KEYWORDS

Construction industry – 2, 82, 124, 268, 337, 526
Construction management – 260
Construction materials management - 496
Construction output – 2
Construction procurement – 202, 455
Construction professionals – 327
Construction Project Management - 517
Construction workers - 477
Contextual factors - 285
Contract stages - 124
Contracting for Design-Build services - 202
Contractors - 162
Cost – 24, 191
Cost overruns – 124, 268
Cultural fit - 409
Culture - 309
Curriculum development - 44

D

Delivery – 53
Delivery time – 357, 376
Design-build practices - 202
Design documentation quality – 102
Design - 376
Design process - 102
Developing countries – 34, 285, 337
Duties of a management contractor - 455

E

Executing Design-Build projects - 202
Elemental cost plan – 60

INDEX OF KEYWORDS

Employee satisfaction - 409
Employee's safe acts – 319
Enterprise development - 418
Environment - 182
Environmental sustainability - 53
EPWP – 172
Ergonomics - 386
ESKOM - 268
E-tendering – 426
Exploratory Factor Analysis - 477

F

Factory - 367
Financial performance - 92
Final tender sum - 60
Forecasting - 14
Forecasting techniques – 2
Framework - 162

G

Gauteng - 477
Ghana - 337
Ghanaian - 309
Globalization readiness - 142
Grand Egyptian Museum – 295
Green architecture - 446
Green Building – 182, 191
Growth - 550

H

Hazards - 367

INDEX OF KEYWORDS

Health and Safety – 152, 220, 240, 285, 319, 386, 399

Higher education – 44

Historical development - 337

Housing development – 53

Housing - 465

Housing policy – 209

Hybrid concrete construction - 436

I

Implementation – 182

Industry - 426

Influencing factors – 102

Infrastructure - 426

Infrastructure development – 112

Information - 538

Information Technology - 538

Innovative financing model – 112

Innovative technology – 260

In-situ concrete – 436

Institution - 465

Integrated Project Delivery – 446

Intelligent buildings - 446

International markets - 92

K

Kaduna-Nigeria - 399

L

Labour - 436

Labour-intensive construction – 172

Lagos metropolis - 229

Lesotho – 220

Load shedding - 268

Low income housing development - 209

INDEX OF KEYWORDS

Low-income housing - 34

M

Maintenance management – 135

Management – 357

Management contracting - 455

Management quality - 376

Marketing - 327

Materials selection - 496

Materials usage - 496

Material waste – 124

Mega infrastructure projects – 249

Merger - 409

Multinational companies – 92

Multinational construction projects - 295

Model - 71

Modeling – 24

Motivation - 277

N

New Zealand – 60

Nigeria – 162, 229, 240, 348, 465

P

Perceptions – 240

Planning - 399

PPE – 367

PPPs – 418, 465

Policy – 34

Practitioners - 426

Prediction - 71

INDEX OF KEYWORDS

Predictive - 24
Private sector – 34
Procurement – 82, 152, 526
Procuring Design-Build services – 202
Productivity – 277
Professional services - 327
Project – 82, 285
Project complexity – 249
Project leadership – 249
Project management – 249, 260
Project performance – 249, 486
Property attributes – 229
Property market - 538
Public Private Partnerships – 112
Public sector - 152

Q

Quality – 357
Quality management - 486

R

Real estate investment – 229
Real Estate Transactions - 538
Required competencies for a management contractor - 455
Relationship – 24
Reliability – 60
Review – 71
Rewards – 277
Risk - 327
Risk allocation – 112
Risk Management – 295

INDEX OF KEYWORDS

Roads – 418

Rural skills transfer – 418

S

Satisfaction – 82

Safety – 367

Safety performance – 477

Service Delivery - 517

SMEs contractors – 142, 319, 526, 550

Social media - 538

South Africa – 44, 92, 102, 142, 172, 486

Spatial planning - 209

Specialist knowledge - 191

Stakeholders – 82

Stakeholder management - 337

Strategies - 182

Strategic management - 135

Studio-based pedagogy – 44

Style - 357

Supervision – 277

Supply chain integration - 526

Supply Chain Management - 517

Sustainable building construction – 496

Sustainable development - 496

Support vector machine – 14

Sustainability - 182

SWOT - 162

Systematic review - 2

T

Targeted procurement - 526

INDEX OF KEYWORDS

Tender Price Index – 71
Time overruns - 268
Theory – 34
Toolkit - 285
Traditional building procurement – 60
Trends - 277

U

Universities – 135
Urban Centres - 465

V

Value for Money – 112
Valuers - 229
Variability - 24

W

Women - 386
Workers – 220, 240
Workforce - 386

Z

Zimbabwe - 152

